

City Council of Hyattsville, Maryland

AGENDA

City Council Regular Meeting

Monday, March 6, 2017

7:30 PM



Council Chambers

Hyattsville Municipal Building

4310 Gallatin Street, 3rd Floor

Hyattsville, MD 20781

(301) 985-5000 www.hyattsville.org

CITY COUNCIL

[Mayor Candace B. Hollingsworth](#)

[Edouard Haba, Council President, Ward 4](#)

[Bart Lawrence, Council Vice President, Ward 1](#)

[Kevin Ward, Ward 1](#)

[Robert S. Croslin, Ward 2](#)

[Shani N. Warner, Ward 2](#)

[Patrick A. Paschall, Ward 3](#)

[Thomas Wright, Ward 3](#)

[Paula J. Perry, Ward 4](#)

[Ruth Ann Frazier, Ward 5](#)

[Joseph Solomon, Ward 5](#)

ADMINISTRATION

Tracey E. Nicholson, City Administrator

Laura Reams, City Clerk, 301-985-5009, lreams@hyattsville.org

WELCOME TO THE CITY OF HYATTSVILLE CITY COUNCIL MEETING! Your participation at this public meeting is valued and appreciated.

Agenda/Packet: The Agenda/Packet is available for review at the Hyattsville Municipal Building and online at www.hyattsville.org prior the scheduled meeting (generally available no later than the Friday prior to the scheduled Monday meeting). Please note, times given for agenda items are estimates only. Matters other than those indicated on the agenda may also be considered at Council discretion.

Americans with Disabilities Act: In compliance with the ADA, if you need special assistance to participate in this meeting or other services in conjunction with this meeting, please contact the City Clerk's Office at (301) 985-5009. Notification 48 hours prior to the meeting will enable the City to make reasonable arrangements to ensure accessibility to this meeting.

Audible Devices: Please ensure all audible devices are turned off or otherwise not audible when the City Council is in session. Thank you.

Consent Agenda: Items listed on the Consent agenda are considered to be routine in nature, and are normally approved by one motion. Please note that most items on the Consent agenda have been discussed at a previous meeting. If a Councilmember wishes to comment on a particular item, that item shall be removed from the Consent agenda to "action" to allow for additional discussion.

Public Input: If you wish to address the Council during the Public Comment period, please submit an Audience Participation Form to the City Clerk prior to the beginning of the meeting. Matters identified during Public Comment that are not on that meeting's agenda will be referred to staff for follow-up or considered on a future agenda. Issues that require a response will be addressed publically at the next regular Council meeting. Speakers are requested to keep their comments to no more than two (2) minutes per speaker. Written comments or supporting documents may be turned in to the City Clerk for distribution to the Mayor and Council.

Ways to Watch the Meetings Live: City Council meetings are broadcast live on cable television channel 71 (Comcast) and channel 12 (Verizon). You may also view meetings live online at hyattsville-md.granicus.com/MediaPlayer.php?camera_id=2

Replay Schedule: The meetings will be re-broadcast on cable television, channel 71 (Comcast) and channel 12 daily at 7:00 a.m., 1 p.m., and 8 p.m. Meetings are also able for replay online at www.hyattsville.org/councilagendas.

City Information: Sign up to receive text and email notifications about Hyattsville events, government, police and programs at www.hyattsville.org/list.aspx

Inclement Weather: In the event of inclement weather, please call 301-985-5000 to confirm the status of the Council meeting.



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1. Call to Order and Council Roll Call

2. Pledge of Allegiance to the Flag

3. Approval of Agenda

4. Motion to Close (7:30 p.m. - 8:00 p.m.)

4.a) Motion to Close

I move that the Mayor and Council close the Council Meeting of March 6, 2017 in order to consult with the City Attorney to obtain legal advice pertaining to contract negotiations, to discuss such contract negotiations and to consider the investment of public funds.

This session will be closed under the authority of the Annotated Code of Maryland State Government General Provisions Article Section 3-305(b) (5) to consider the investment of public funds, (7) to consult with counsel to obtain legal advice and (14) to discuss, before a contract is awarded or bids are opened, a matter directly related to a negotiating strategy or the contents of a bid or proposal, if public discussion or disclosure would adversely impact the ability of the public body to participate in the competitive bidding or proposal process.

Motion #: 141-03-FY17

Sponsor(s): At the Request of the City Administrator

[Motion to Close cover.pdf](#)

5. Public Comment (8:00 p.m. – 8:10 p.m.) Limit 2 minutes per speaker

6. Presentations (8:10 p.m. - 8:45 p.m.)

6.a) City Administrator Update (5 minutes)

Motion #: Presentation Only

Sponsor(s): At the Request of the City Administrator

[City Administrator Update cover.pdf](#)

6.b) Presentation of Check to Special Olympics of Prince George's County (5 minutes)

Motion #: Presentation Only

Sponsor(s): At the Request of the City Administrator

[Special Olympics Presentation cover.pdf](#)

6.c) Health, Wellness & Recreation Advisory Committee: FY18 Budget Recommendations (10 minutes)

Motion #: Presentation, with Associated Discussion Items

Sponsor(s): Solomon, Ward, Perry

[HWRAC Presentation cover.pdf](#)

[HWRAC City Council Presentation.pdf](#)

6.d) Hyattsville Community Development Corporation Program Update (15 minutes)

Motion #: Presentation Only

Sponsor(s): Hollingsworth, Haba, Lawrence

[HY CDC Presentation cover.pdf](#)

[HYCDC CoH Presentation 030617.pdf](#)

7. Consent Items (8:45 p.m. - 8:50 p.m.)

7.a) FY17 Budget Appropriation: Share Our Strength Farmers Market Grant

I move that the Mayor and Council accept and appropriate in the FY17 budget a \$7,000 grant from Share Our Strength to provide nutritional tours at the City's Farmers Market.

Motion #: 142-03-FY17

Sponsor(s): At the Request of the City Administrator

[Share our Strength Grant cover.pdf](#)

[Share Our Strength Grant Farmers Market.pdf](#)

7.b) Women's History Month Proclamation

I move that the Mayor and Council proclaim March Women's History Month in Hyattsville.

Motion #: 143-03-FY17

Sponsor(s): At the Request of the City Administrator

[2017 Womens History Month Proclamation cover.pdf](#)

[Womens History Month 2017.docx](#)

7.c) Microsoft Office 365 Licenses Purchase

I move that the Mayor and Council authorize the City Administrator to accept the proposal submitted by Dataprise Inc., 9600 Blackwell Road, Rockville, Maryland 20850 for the acquisition of Microsoft Office 365 licenses at a total cost not to exceed \$18,000.

Motion #: 144-03-FY17

Sponsor(s): At the Request of the City Administrator

[Office 365 cover.pdf](#)

7.d) Hyattsville CDC: Request for Prince George's Arts & Humanities Council Letter of Support

I move to authorize the Mayor, on behalf of the City of Hyattsville, to provide a letter of support to the Hyattsville Community Development Corporation for its Prince George's Arts & Humanities Council grant application for the expansion of the CDC's traffic box art wrap project.

Motion #: 145-03-FY17

Sponsor(s): Hollingsworth, Perry, Ward, Wright

[HY CDC LOS PGAH Grant.pdf](#)

[HCDC LOS Art Box Wrap.docx](#)

7.e) Hyattsville CDC: Request for Maryland Heritage Area Authority Letter of Support

I move to authorize the Mayor, on behalf of the City of Hyattsville, to provide a letter of support to the Hyattsville Community Development Corporation for its Maryland Heritage Area Authority grant application.

Motion #: 146-03-FY17

Sponsor(s): Hollingsworth, Perry, Ward, Wright

[HY CDC LOS MHAA Grant.pdf](#)

[Draft COH LOS CDC MHAA Grant Application.docx](#)

7.f) Anacostia Trails Heritage Area Inc. (ATHA) Request for Preservation Maryland Letter of Support

I move to authorize the Mayor, on behalf of the City of Hyattsville, to provide a letter of support to Anacostia Trails Heritage Area Inc. for its Preservation Maryland grant application.

Motion #: 147-03-FY17

Sponsor(s): Hollingsworth, Perry, Ward, Wright

[ATHA LOS Preservation MD Grant.pdf](#)

[ATHA support letter.docx](#)

8. Discussion Items (8:50 p.m. - 9:40 p.m.)

8.a) Mt Rainier's Request for HCPD to Provide Dispatch Services (10 minutes)

Motion #: Discussion, Scheduled for Action 3/20/17

Sponsor(s): At the Request of the City Administrator

[MR Dispatch Services cover.pdf](#)

8.b) HWRAC FY18 Budget Priority: Hyattsville Welcome Packet (10 minutes)

I move that Mayor and Council accept the publication and distribution of a Hyattsville Welcome Packet as a Hyattsville budget priority to be funded FY18 Hyattsville municipal budget.

Motion #: Discussion, Action TBD

Sponsor(s): Solomon, Ward, Perry

[HWRAC Discussion Welcome Packet cover.pdf](#)

[Staff Comments Welcome Packet-3-6-17.docx](#)

[City of Romulus Complete Welcome Packet 12.16.pdf](#)

8.c) HWRAC FY18 Budget Priority: Hyattsville Health Assessment (10 minutes)

I move that the Mayor and Council accept the preparation of a Hyattsville Health Assessment and Action Plan as a City of Hyattsville budget priority to be funded in the FY18 Hyattsville municipal budget.

Motion #: Discussion, Action TBD

Sponsor(s): Solomon, Ward, Perry

[HWRAC Discussion Health Assessment cover.pdf](#)

[Staff Comments Health Assessment-3-6-17.docx](#)

[Sample Health Assessment](#)

[2010 Census Tracts City Boundary.pdf](#)

8.d) HWRAC FY18 Budget Priority: Health Impacts of Climate Change Seminars (5 minutes)

I move that the Mayor and Council include Health Impacts of Climate Change Seminars as a City budget priority to be funded in the FY18 Hyattsville municipal budget.

Motion #: Discussion, Action TBD

Sponsor(s): Solomon, Ward, Perry

[HWRAC Discussion Climate Change cover.pdf](#)

[a human health perspective on climate change full report 508.pdf](#)

8.e) Hyattsville Senior Nutrition Program Partnership (15 minutes)

I move that the Mayor and Council authorize the City Administrator to negotiate and execute Memorandums of Understandings with College Park Meals on Wheels, Prince George's County Department of Family Services, and Prince George's Public Schools for the purposes of implementing a Senior Nutrition Program in the City. I further move that the Mayor and Council authorize FY18 funding for the program in an amount not to exceed \$25,000.

Motion #: Discussion, Action TBD

Sponsor(s): Solomon

[Senior Nutrition cover.pdf](#)

[Staff Comments on Senior Nutrition Program 03-06-17.docx](#)

9. Council Dialogue (9:40 p.m. - 9:50 p.m.)

10. Community Notices and Meetings

10.a) City Calendar: March 7-15, 2017

Motion #: N/A

Sponsor(s): At the Request of the City Administrator

[Main City Calendar Mar 7-15 2017.docx](#)

11. Motion to Adjourn



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: City Clerk

Item Type: Legislative

Agenda Section: Motion to Close (7:30 p.m. - 8:00 p.m.)

SUBJECT

Motion to Close

Motion #

141-03-FY17

Recommendation:

I move that the Mayor and Council close the Council Meeting of March 6, 2017 in order to consult with the City Attorney to obtain legal advice pertaining to contract negotiations, to discuss such contract negotiations and to consider the investment of public funds.

This session will be closed under the authority of the Annotated Code of Maryland State Government General Provisions Article Section 3-305(b) (5) to consider the investment of public funds, (7) to consult with counsel to obtain legal advice and (14) to discuss, before a contract is awarded or bids are opened, a matter directly related to a negotiating strategy or the contents of a bid or proposal, if public discussion or disclosure would adversely impact the ability of the public body to participate in the competitive bidding or proposal process.

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

Summary Background:

N/A

Next Steps:

N/A

Fiscal Impact:

N/A

City Administrator Comments:

Recommend Approval

Community Engagement:

N/A

Strategic Goals:

N/A

Legal Review Required?

Complete



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: Administration

Item Type: Report

Agenda Section: Presentations (8:10 p.m. - 8:45 p.m.)

SUBJECT

City Administrator Update (5 minutes)

Motion #

Presentation Only

Recommendation:

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

Summary Background:

City Administrator Nicholson will provide a brief update to the Mayor, Council and Residents.

Next Steps:

N/A

Fiscal Impact:

N/A

City Administrator Comments:

N/A

Community Engagement:

N/A

Strategic Goals:

Goal 1 - Ensure Transparent & Accessible Governance

Legal Review Required?

N/A



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Jake Rollow

Submitting Department: Community Services

Item Type: Presentation

Agenda Section: Presentations (8:10 p.m. - 8:45 p.m.)

SUBJECT

Presentation of Check to Special Olympics of Prince George's County (5 minutes)

Motion #

Presentation Only

Recommendation:

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

Summary Background:

Arrow Bicycle hosts the Hyattsville Cyclocross in partnership with the City of Hyattsville to raise funds for Special Olympics of Prince George's County.

Next Steps:

NA

Fiscal Impact:

NA

City Administrator Comments:

NA

Community Engagement:

Special Olympics of Prince George's County athletes will be in attendance.

Strategic Goals:

Strengthen the City's identity as a diverse, creative and welcoming community.

Legal Review Required?

NA



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: Legislative

Item Type: Presentation

Agenda Section: Presentations (8:10 p.m. - 8:45 p.m.)

SUBJECT

Health, Wellness & Recreation Advisory Committee: FY18 Budget Recommendations (10 minutes)

Motion #

Presentation, with Associated Discussion Items

Recommendation:

Sponsor(s):

Solomon, Ward, Perry

ATTACHMENTS

[HWRAC Presentation_cover.pdf](#)

[HWRAC City Council Presentation.pdf](#)

Summary Background:

The Health, Wellness and Recreation Advisory Committee will present the budget initiatives submitted, on their behalf, by Councilmembers Solomon, Ward and Perry and respond to questions from the Council on the initiatives.

Next Steps:

The initiatives are on the Council discussion agenda for March 6.

Fiscal Impact:

N/A

City Administrator Comments:

N/A

Community Engagement:

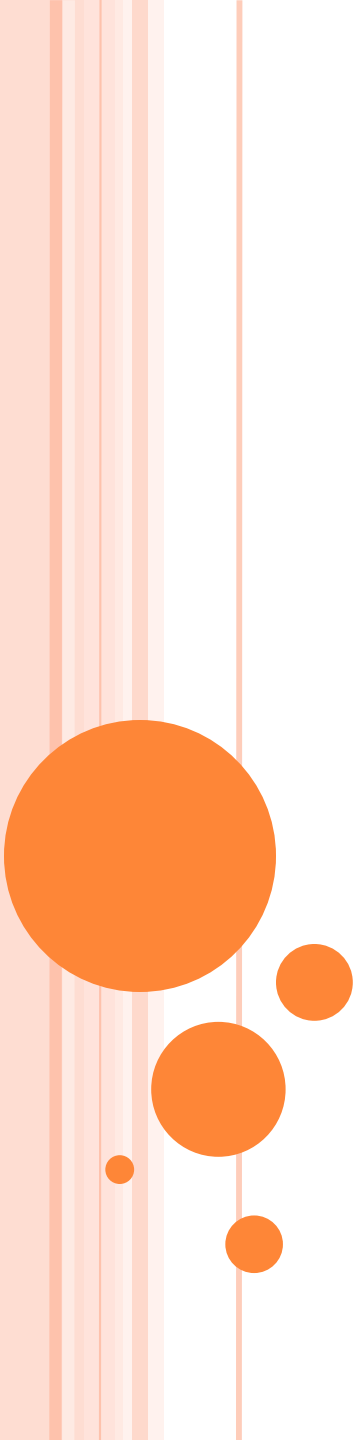
N/A

Strategic Goals:

Goal 1 - Ensure Transparent & Accessible Governance

Legal Review Required?

N/A



HEALTH, WELLNESS, AND RECREATION ADVISORY COMMITTEE

March 6, 2017

HWRAC THEME FOR 2017

✧ Community Engagement

- ✧ Lays a building block for information sharing and health promotion
- ✧ Helps reduce isolation and increases social cohesion
- ✧ Supports the city's commitment to foster a more welcoming environment

Engaging community members in problem-solving solutions to issues that affect them is one of the fundamental principles of public health

- Minnesota Department of Health



WELCOME TO HYATTSVILLE

✧ Proposal

- ✧ New residents will receive a welcome packet (hard or e-copy). The packet will include a Welcome to Hyattsville letter, a table of contents, and a list of local and city resources (i.e., transportation, health events, health and recreation facilities, and special activities).
- ✧ The packet will be put together and updated by the HWRAC with the help of volunteers. A third party will print and distribute the packets at a nominal cost.

✧ Impact

- ✧ Promotes social cohesion; informs citizens about government services and community based organizations that foster health and wellness; engages hard to reach populations and non-English speaking neighbors; and reduces city-staff burden

✧ Anticipated Cost

- ✧ \$5,000



HEALTH IN CONTEXT

✧ Proposal

- ✧ HWRAC will collaborate with public health researchers to write a report that analyzes the health status, needs, and disparities in Hyattsville.

✧ Impact

- ✧ This health assessment will provide a statistical catalogue of the city's public health (i.e., rates on health care insurance, life expectancy, education attainment, Emergency Room utilization, mental health, employment, quality of life).
- ✧ Hyattsville stakeholders will refer to this health assessment to understand the health needs and to prioritize programming.
- ✧ This snapshot is an evidence-based tool that identifies the assets and areas of opportunity in our pursuit of a healthier city.

✧ Anticipated Cost

- ✧ \$10,000



HEALTH PROMOTION

✧ Proposal

- ✧ HWRAC will partner with local health experts to develop and implement public awareness events about health disparities.
- ✧ This year we will focus on climate change.

✧ Impact

- ✧ This public awareness event will dispel myths as well as educate our neighbors about the health impacts of climate change on maternal health outcomes.

✧ Anticipated Cost

- ✧ \$2,000



NEXT STEPS

- ✧ We **thank you** for your time and consideration
 - ✧ City Council Liaisons: Joseph Solomon & Kevin Ward
 - ✧ Staff Liaisons: Cheri Everhart & Ellarose Preston
 - ✧ HWRAC Members
 - ✧ SADE ADEEYO, Chair
 - ✧ ABDOULAYE BANGOURA
 - ✧ LAUREN COMEAU
 - ✧ JULIA CROOKS
 - ✧ SUSAN HOLLAND
 - ✧ GERRARD JOLLY
 - ✧ PATRICIA PAGE
 - ✧ ALLISON WALTERS
 - ✧ DYANN WAUGH

✧ Questions





Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: City Clerk

Item Type: Presentation

Agenda Section: Presentations (8:10 p.m. - 8:45 p.m.)

SUBJECT

Hyattsville Community Development Corporation Program Update (15 minutes)

Motion #

Presentation Only

Recommendation:

Sponsor(s):

Hollingsworth, Haba, Lawrence

ATTACHMENTS

[HYCDC_CoH Presentation_030617.pdf](#)

Summary Background:

The Hyattsville Community Development Corporation will present updates on upcoming programs and projects to the Mayor and Council.

Next Steps:

N/A

Fiscal Impact:

N/A

City Administrator Comments:

N/A

Community Engagement:

N/A

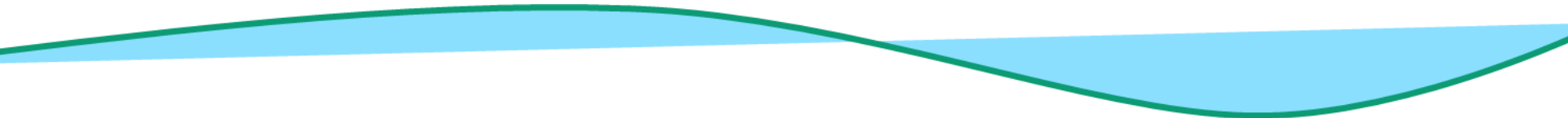
Strategic Goals:

N/A

Legal Review Required?

N/A

CONTENTS



- ARTWAYS: SCULPTURAL SIGNAGE & MAPPING: UPDATE
- BURSTING ON THE SCENE: A COMMUNITY PAINT PARTY
- GATEWAY ARTS DISTRICT: LEARNING RESOURCE GUIDE
- ARTS & ALES: 10TH ANNUAL DOWNTOWN HYATTSVILLE ARTS FESTIVAL
- TRAFFIC BOX WRAPS
- STREAM VALLEY ARTWAY
- OTHER COLLABORATIONS TO CONSIDER

ARTWAYS:

Sculptural Signage & Mapping

PROJECT UPDATE

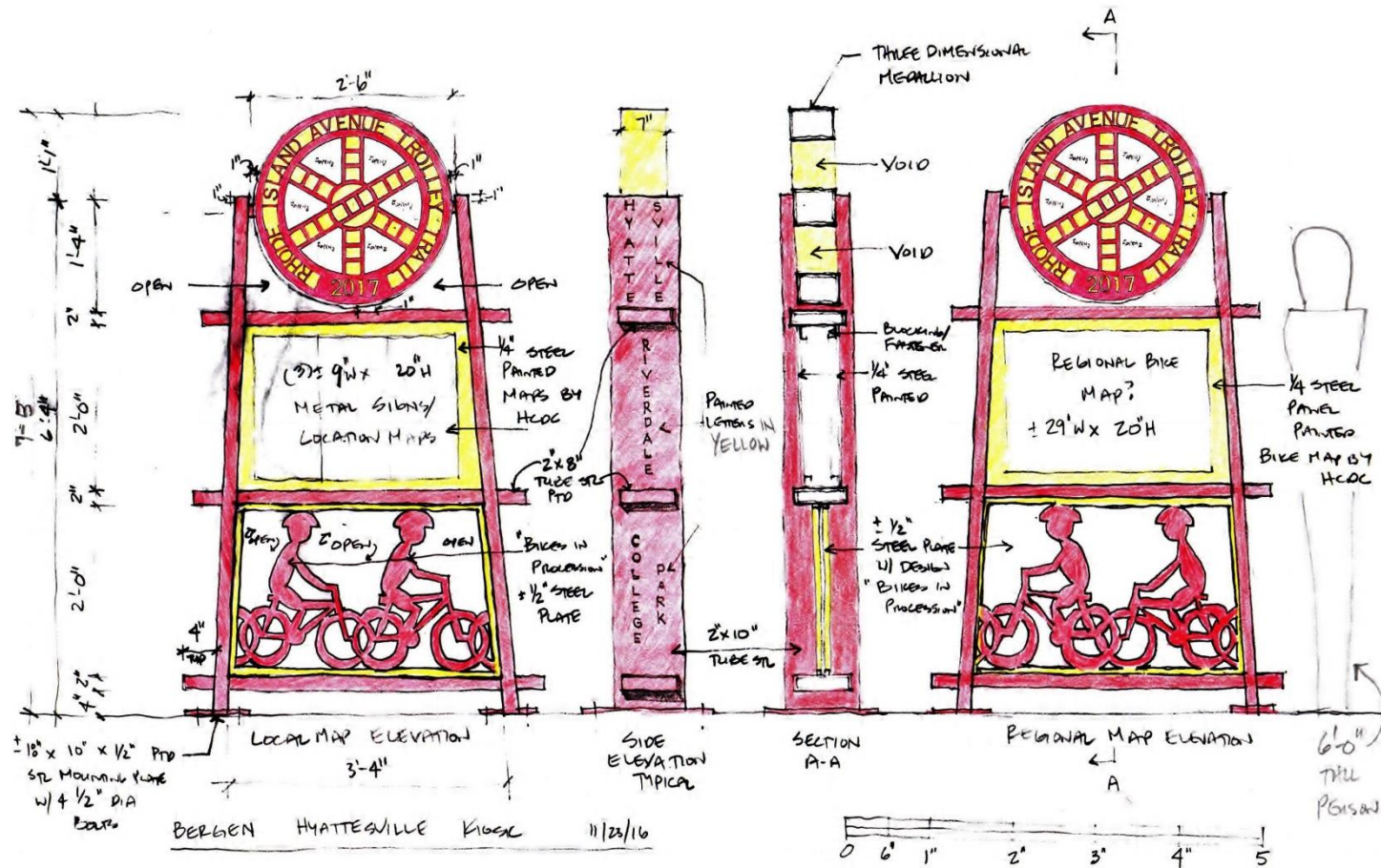
PROJECT & PURPOSE

- Produce sculpturally-inspired signage for the trail system
- Connect trail intersections with local economic development nodes, heritage tourism, or other activity centers
- Sign information to be coordinated with local municipalities, ATHA, and M-NCPPC

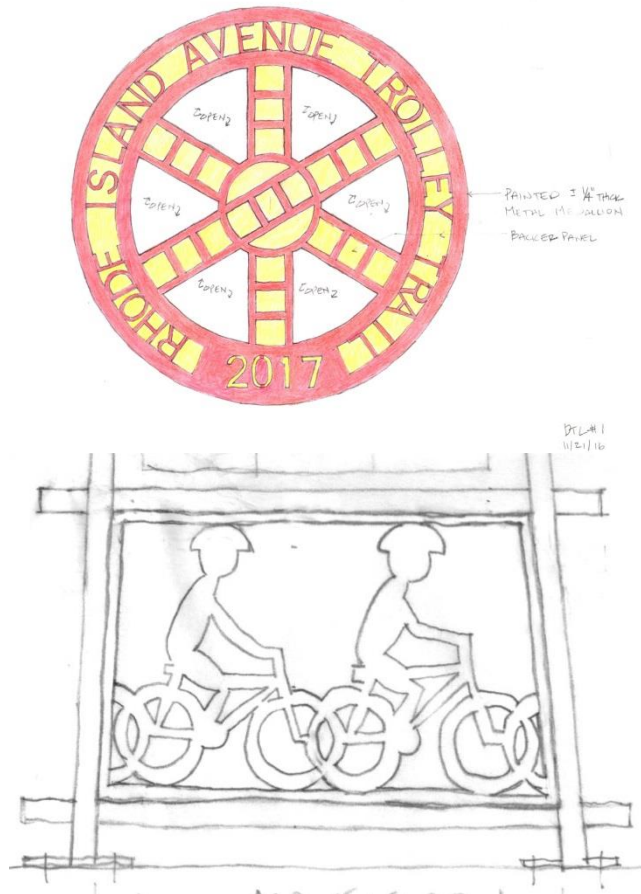
DESIGN REQUIREMENTS

- Optional unique elements
- Easily replicated main structure
- Allow for easy insert/removal of customized local information

CONCEPTUAL DESIGN



CONCEPTUAL DESIGN



- Consistent branding across trail
- Ties in with Heritage Area
- Functional and Unique

POTENTIAL LOCATIONS



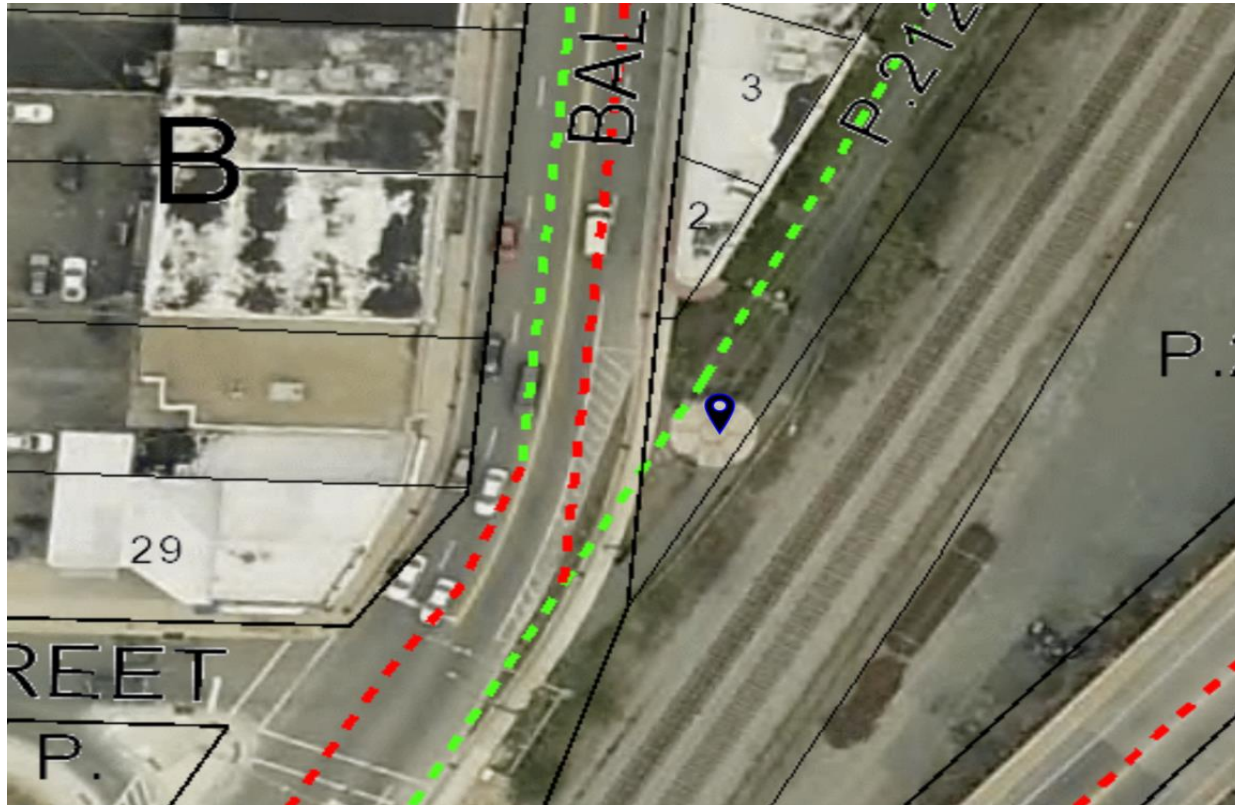
Location: Shoppes at Arts District

Owner: ARTS DIST HYATTSVL MSTR ASSOC INC

Pro: Private land, close to downtown, trail already there

Con:

POTENTIAL LOCATIONS



Location: Current Terminus of Trail at Farragut St

Owner: M-NCPPC

Pro: Very visible, current end of trail

Con: Small site, Would need M-NCPPC permission

 **RAIN**
DATE
MAY 21



BURSTING

**ON THE
SCENE**

A CITIZEN PAINT PROJECT PUBLIC ART PARTY

**SATURDAY,
MAY 13
12PM - 5PM**



WEST HYATTSVILLE METRO

PEDESTRIAN UNDERPASS

<http://hycdc.org/bursting>

Celebrate Hyattsville's regional growth and continue upon the TDOZ discussion with a fun and engaging way to beautify a popular but plain public space. Join muralists who will lead the community in two paint-by-numbers murals, alongside refreshments and kid-friendly activities.

ORGANIZED BY
HYATTSVILLE
Community Development Corp

PROJECT & PURPOSE

- To celebrate the West Hyattsville community in a festive environment
- To bring together residents to beautify a public space
- Mural artist(s) will be selected through the Art In Transit RFP “Call for Artists” process and will be reviewed by a locally empaneled jury

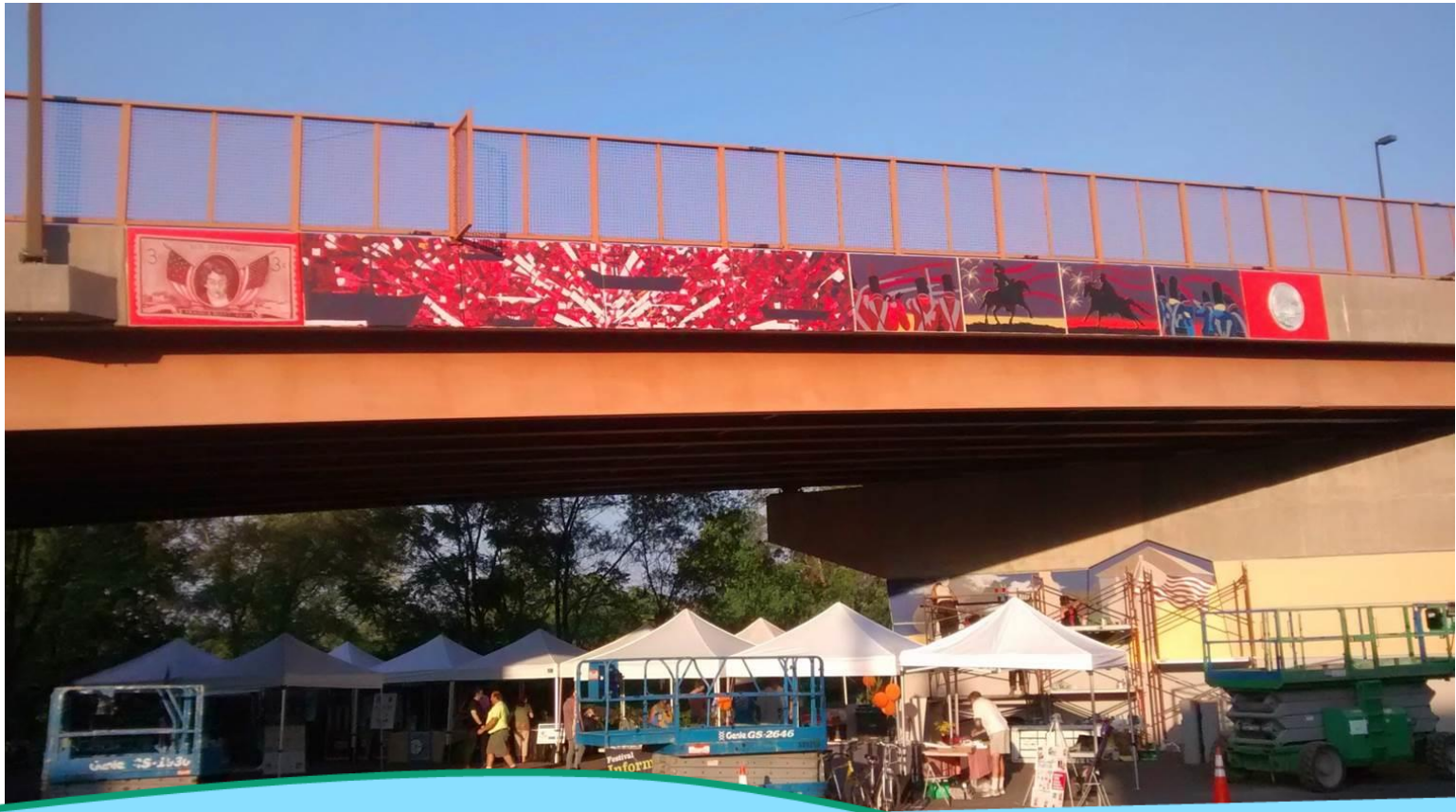
PLACEMAKING THROUGH ART



BURSTING
IN AIR ARTS HAPPENING
PUBLIC ART PARTY
SAT JULY 26 3-8PM
5123 BALTIMORE AVE HYATTSVILLE, MD



EVENT DAY, 2014: BURSTING IN AIR



EXISTING CONDITIONS



ART WILL LIVE HERE



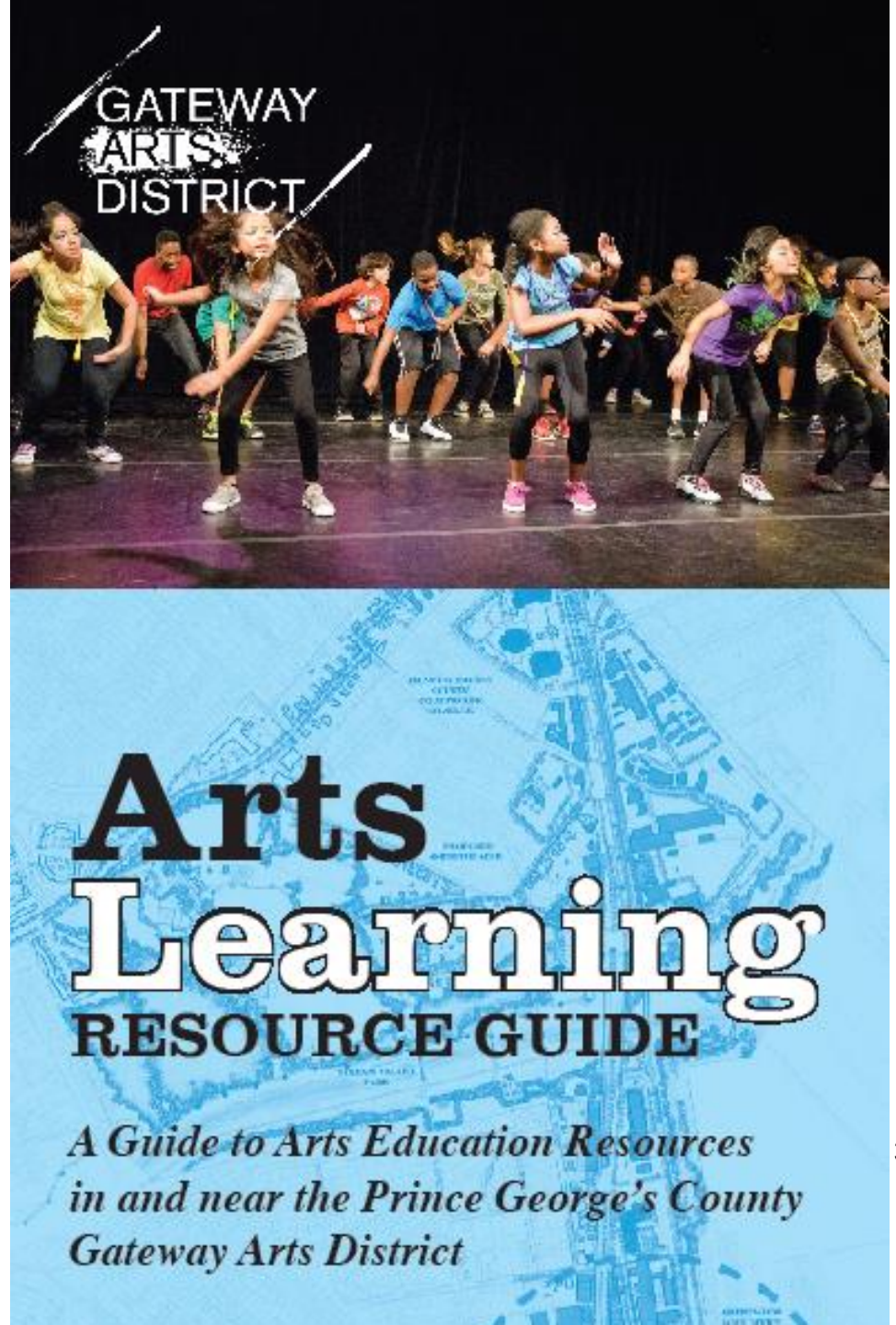
PROJECT & PURPOSE

FROM A MSAC TECHNICAL
ASSISTANCE GRANT FOR ARTS
DISTRICTS

A COLLABORATION OF
HYATTSVILLE CDC & JOE'S
MOVEMENT EMPORIUM

TO HIGHLIGHT THE MOST
IMPORTANT GATEWAY ARTS
DISTRICT PROGRAMMING
COMPREHENSIVELY

TO ROUND OUT THE BROAD
VARIETY OF COMMUNITY
RESOURCE GUIDES HYATTSVILLE
CDC PROVIDES ON ITS WEB-
BASED SERVICE PLATFORMS



THE GATEWAY ARTS DISTRICT: SEEK AND YOU WILL FIND

After School

After School Programs

Joe's Movement Emporium

Club Joe's, Ages 5 - 13
3309 Bunker Hill Rd, Mount Rainier, MD 20712
www.joesmovement.org
301-699-1819

Art Works Now

Art Works @ Schools, Ages 5 - 11
3711 Rhode Island Ave, Mount Rainier, MD 20712
www.artworksnow.org
301-454-0808

After School Classes

Adinkra Cultural Arts Studio

African Drummer & Dancing and Hip Hop, Ages 7- 12
3804 34th St, Mount Rainier, MD 20712
adinkrastudios.com
240-490-2227

Ballet, Tap & All That Jazz

Beginning Ballet, Beginning Tap, Beginning Jazz
Ages 5- 10, 10- 15
5103 Baltimore Ave, Hyattsville, MD 20781
240-492-9331
ballettapandallthatjazz.org

Farafina Kan: The Sound of Africa

African Drum & Dance classes, Ages 9- 12
3802 34th St, Mount Rainier, MD 20712
farafinkan.com

Just Rock Enterprises

Individual lesson, All Ages
4344 Farragut St, 2nd Fl, Hyattsville, MD 20781
202-570-4860
www.justrockenterprises.com



Special Needs

Movement

Joe's Movement Emporium

Classroom Movement Experience
The ARC of Prince George's County Dance Classes
3309 Bunker Hill Rd, Mount Rainier, MD 20712
www.joesmovement.org
301-699-1819

Visual Arts

Art Enables

An arts-based training and employment placement program
for persons with developmental disabilities
2204 Rhode Island Ave NE, Washington, DC 20018
www.art-enables.org
202-554-9455

Art Works Now

Accessible Studio
Teens & Adults
3711 Rhode Island Ave, Mount Rainier, MD 20712
www.artworksnow.org
301-454-0808

Brentwood Arts Exchange

M-NCPPC, Department of Parks and Recreation
The ARC of Prince George's County Art Classes
3901 Rhode Island Ave, Brentwood, MD 20722
arts.pcparks.com
301-277-2863

Prince George's African American Museum and Cultural Center

Onsite and offsite programming
4519 Rhode Island Ave, North Brentwood, MD 20722
www.pgeaamcc.org
301-809-0440

Organizations

The ARC of Prince George's County
301-925-7050
1401 McCormick Dr. Largo, Maryland 20774



DOWNTOWN HYATTSVILLE ARTS AND ALES FESTIVAL

downtown
hyattsville
arts & ales
festival
www.hyattsvillearts.com

Sept. 23, 2017



TRAFFIC BOX ART WRAPS

VOTE
ONLINE BY
3/24/17

[ESPAÑOL](#)[f](#)[t](#)[in](#)[p](#)[ig](#)[t](#)[v](#)[y](#)[s](#)[r](#)

HYATTSVILLE
Community Development Corp

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Traffic Box Art Wraps

Program Description

The Hyattsville Community Development Corporation has released a Call for Artists' designs to transform select traffic signal cabinets in Prince George's County into public artworks representative of community identity and character. Traffic signal cabinets – the grey metal structures located at every signalized intersection – are vulnerable to graffiti and vandalism. This project will utilize a public art application to address community blight and enhance the visual landscape. Artist designs will be printed on vinyl and wrapped around 11 traffic box cabinets in Prince George's County, focusing on boxes located in the county's T.N.I. (Transforming Neighborhoods Initiative) communities. This project is made possible through funding from the Prince George's County Executive Community Partnership Grant and the support of Prince George's Department of Public Works & Transportation.

Now it's your turn to select your favorite designs! The public will vote on the final five designs.

Vote For Your Favorite Wrap Designs Here

VOTING DEADLINE: Friday, March 24th, 2017



The poster features a traffic box with a QR code and the text: 'Vote for Traffic Box Art Wrap Designs In Prince George's County, MD. Voting Closes Friday, March 24th, 5:00 PM. http://hyattsville.org/traffic-box'.

Materials & Updates

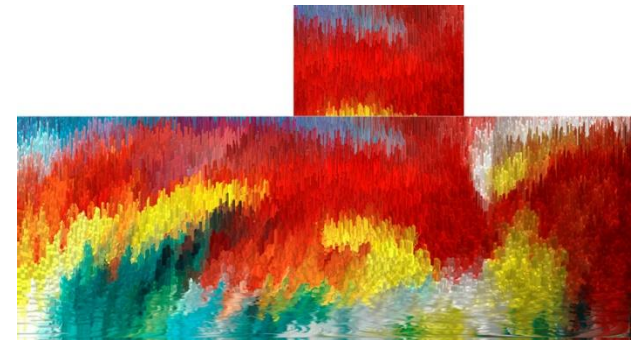
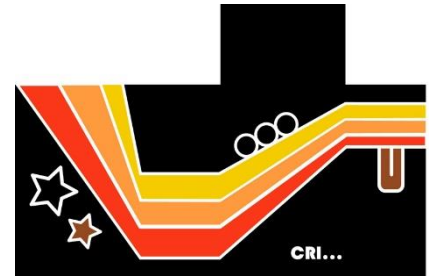
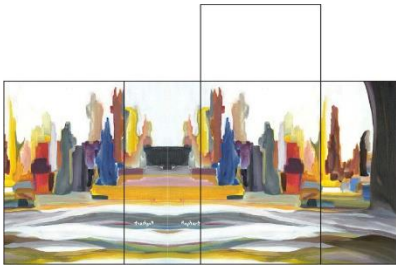
- 2/17/17 – Vote for Traffic Box Art Wrap Designs, Deadline 3/24/17
- 11/30/16 – Call for Artists' Designs
 - Open PDF

Program Partners

- Hyattsville Community Development Corporation
- Prince George's County Executive Community Partnership Grant
- Prince George's Department of Public Works & Transportation

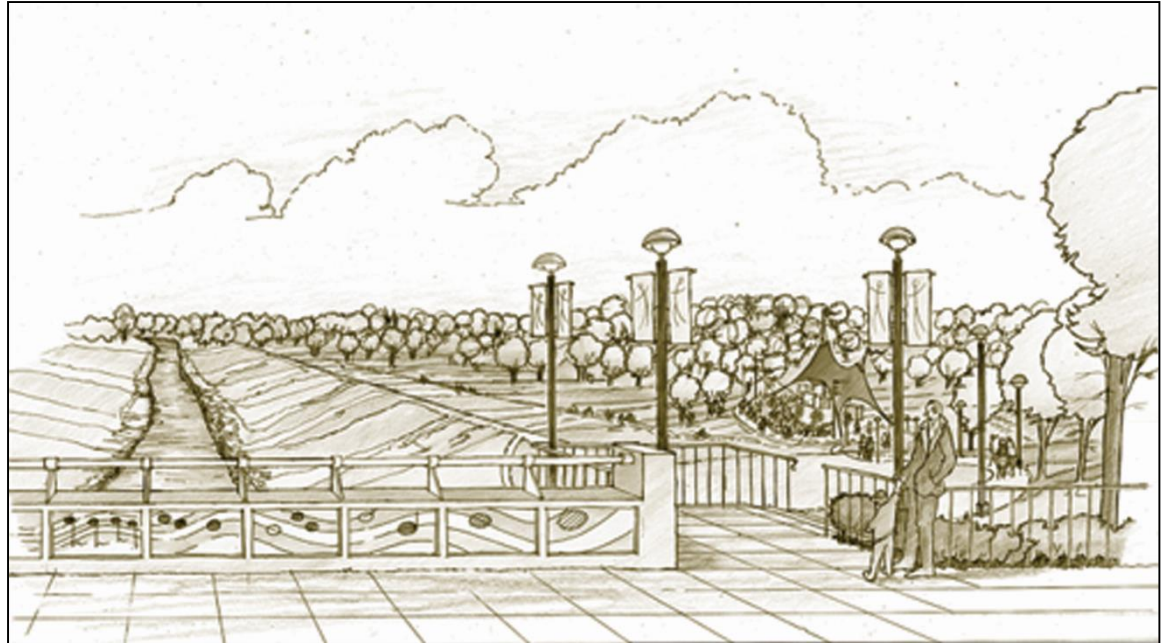
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STREAM VALLEY ARTWAY

- Connect Trolley Trail to Stream Valley Trail through signage
- Promote Stream Valley Artway as it develops

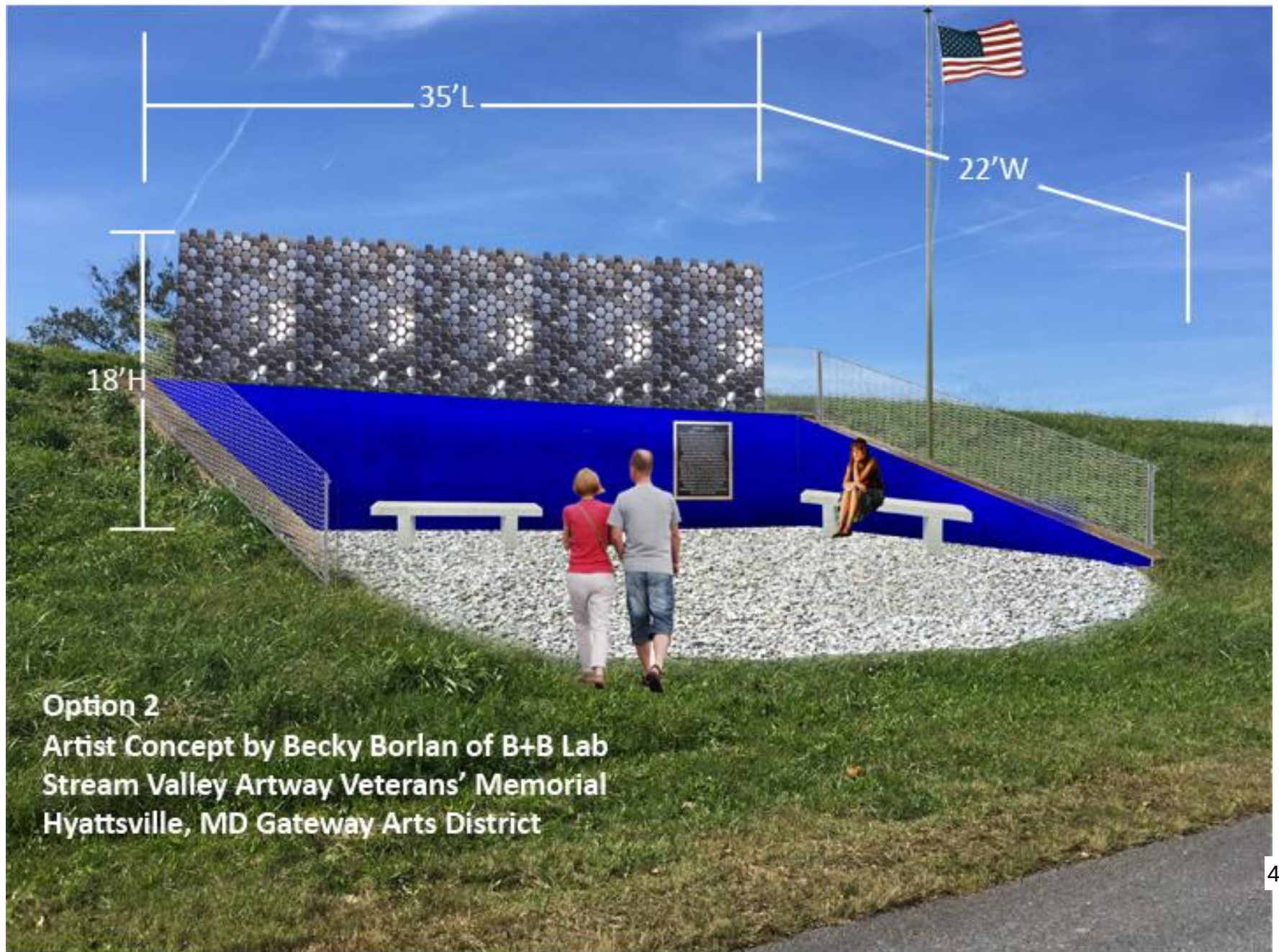


Concept Rendering from GAD Sector Plan

STREAM VALLEY ARTWAY

- Project #1:
Veteran's Memorial
- Project Budget: \$45,000
- \$10,000 raised so far
- Seeking a \$30,000 Bond Bill this session





PARTNER WITH US

- Participate in Design Jury
 - Assist in determining sign locations
 - Collaborate for signage information
 - Support our upcoming grant application
- Support the ARTways and Stream Valley Artway Project



HYATTSVILLE CDC

- Kayleigh Gunnoud, Grants Manager
kgunnoud@hyattsvillecdc.org
(301) 683-8267
- Stuart Eisenberg, Executive Director
eisenberg@hyattsvillcdc.org
(301) 683-8267



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Jake Rollow

Submitting Department: Community Services

Item Type: Legislative

Agenda Section: Consent Items (8:45 p.m. - 8:50 p.m.)

SUBJECT

FY17 Budget Appropriation: Share Our Strength Farmers Market Grant

Motion

142-03-FY17

Recommendation:

I move that the Mayor and Council accept and appropriate in the FY17 budget a \$7,000 grant from Share Our Strength to provide nutritional tours at the City's Farmers Market.

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

[Share our Strength Grant_cover.pdf](#)

[Share Our Strength Grant_Farmers Market.pdf](#)

Summary Background:

Share Our Strength has awarded the City \$7,000 for our matching money program. This grant will allow the City to provide \$10 Vouchers to residents who participate in the nutritional tours at the Hyattsville Farmers Market. The grant will support resident nutritional education and help market goers gain access to fresh, healthy foods at a reduced cost. It also allows increased revenue for our participating vendors and allows the City to expand the benefits to more participants. This is the largest Share Our Strength grant the City has received to date.

Next Steps:

Accept & Appropriate the grant.

Fiscal Impact:

\$7,000

City Administrator Comments:

Recommend Support

Community Engagement:

The Farmers Market is promoted widely.

Strategic Goals:

Goal 2 - Ensure the Long-Term Economic Viability of the City.

Legal Review Required?

NA



SHARE OUR
STRENGTH®
NO KID HUNGRY

1030 15TH STREET NW, SUITE 1100W
WASHINGTON, DC 20005

TEL 800 969 4767
FAX 202 347 5868

NOKIDHUNGRY.ORG

February 15, 2017

Ellarose Preston
City of Hyattsville (Hyattsville Farmers Market)
4310 Gallatin Street
Hyattsville, MD 20781

Dear Ellarose,

We are pleased to provide you with the attached check in the amount of \$7,000.00 awarded to City of Hyattsville (Hyattsville Farmers Market), provided by Share Our Strength. This grant is intended to provide funding to lead Cooking Matters at the Store grocery store tours in your community. The grant funds shall be used for this purpose only.

If you have any questions about your grant, please contact Liz Evancho, Associate Director, Grants, at eevancho@strength.org. We wish you the best of success and look forward to hearing about your continued success.

Sincerely,

Bill Shore
Founder and CEO

Check payee name: City of Hyattsville



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Jake Rollow

Submitting Department: Community Services

Item Type: Legislative

Agenda Section: Consent Items (8:45 p.m. - 8:50 p.m.)

SUBJECT

Women's History Month Proclamation

Motion #

143-03-FY17

Recommendation:

I move that the Mayor and Council proclaim March Women's History Month in Hyattsville.

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

[Womens_History_Month_2017.docx](#)

Summary Background:

Women's History Month is celebrated in March nationwide.

Next Steps:

Proclaim March Women's History Month.

Fiscal Impact:

NA

City Administrator Comments:

Recommend Support

Community Engagement:

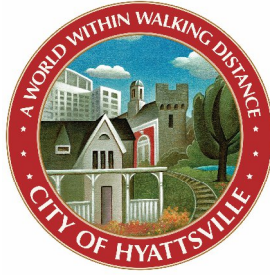
NA

Strategic Goals:

Strengthen the City's identity as a diverse, creating and welcoming community.

Legal Review Required?

NA



Proclamation in Recognition of Women's History Month

*Honoring Trailblazing Women in Labor and
Business*

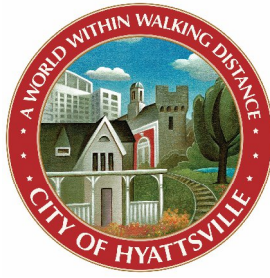
March, 2017

Whereas, Hyattsville is proud to be a City that benefits from the leadership and service of women; and

Whereas, women own many of our local businesses, and serve as leaders and laborers in even more; and

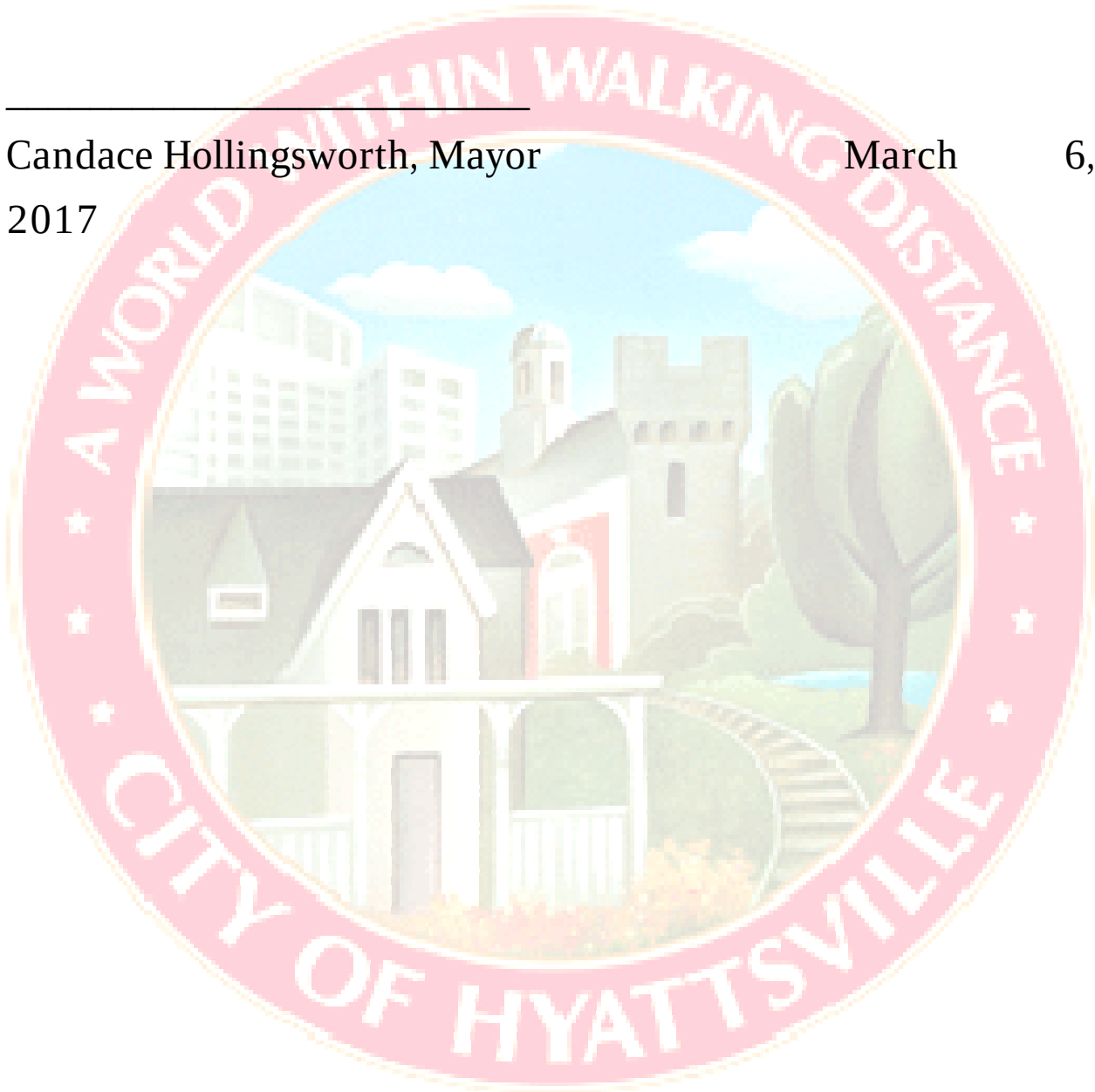
Whereas, as a community we strive to foster equality, celebrate diversity, promote understanding, and support the needs and desires of all residents; and

Therefore, we proclaim March Women's History Month in Hyattsville, and encourage all residents to reflect on this part of our rich history.



Candace Hollingsworth, Mayor
2017

March 6,





Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: Information Technology

Item Type: Purchase

Agenda Section: Consent Items (8:45 p.m. - 8:50 p.m.)

SUBJECT

Microsoft Office 365 Licenses Purchase

Motion #

144-03-FY17

Recommendation:

I move that the Mayor and Council authorize the City Administrator to accept the proposal submitted by Dataprise Inc., 9600 Blackwell Road, Rockville, Maryland 20850 for the acquisition of Microsoft Office 365 licenses at a total cost not to exceed \$18,000.

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

Summary Background:

Planet Technologies has been the City's principal reseller and provider since migrating to Microsoft Office 365 in 2014. Dataprise, the City's contracted IT services provider is also a Microsoft approved reseller of Microsoft Office 365, and the firm expressed interest in providing the City with a competitive cost proposal for services. Both vendors have provided quotes for 61 E1 Users and 68 E3 Users.

- Planet Technologies provided a quote of \$16,365.84 for a one-year term;
- Dataprise Inc. provided a quote of \$16,437.60 for a one-year term

The Planet Technologies quote is \$71.76 per year less than the quote provided by Dataprise Inc., however Planet Technologies does not provide customer support for Microsoft Office 365 as part of its base price, but is available as an additional service at a block rate of \$175 per hour. On-call customer service is included with the Office 365 licenses available through Dataprise Inc. at no additional cost. Staff estimates that throughout a calendar year, the City will require approximately 20-hours of customer service assistance.

Next Steps:

Upon Council approval, staff will proceed with purchasing the licenses.

Fiscal Impact:

Funding for this acquisition is included in the adopted FY2017 City Budget.

City Administrator Comments:

Staff is recommending a total spending authorization that would allow for additional license purchases if necessary.
Recommend Support

Community Engagement:

N/A

Strategic Goals:

Goal 4: Foster Excellence in all City Operations; Action 4.3 – Utilize data, technology and best practices to develop and implement proactive, problem solving strategies and services.

Legal Review Required?

Pending



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: Community & Economic Development

Item Type: Grant

Agenda Section: Consent Items (8:45 p.m. - 8:50 p.m.)

SUBJECT

Hyattsville CDC: Request for Prince George's Arts & Humanities Council Letter of Support

Motion

145-03-FY17

Recommendation:

I move to authorize the Mayor, on behalf of the City of Hyattsville, to provide a letter of support to the Hyattsville Community Development Corporation for its Prince George's Arts & Humanities Council grant application for the expansion of the CDC's traffic box art wrap project.

Sponsor(s):

Hollingsworth, Perry, Ward, Wright

ATTACHMENTS

[HCDC LOS_Art Box Wrap.docx](#)

Summary Background:

The Hyattsville CDC is requesting the City of Hyattsville support its FY18 County Arts grant application to the Prince George's Arts & Humanities Council. The funds are intended to support the printing and installation of artistic vinyl wraps on the traffic boxes located at signalized intersections throughout the City. In July 2016, the Council supported a similar request from the CDC for their grant application to the Maryland DHCD Community Legacy program. Grant funds awarded from the Prince George's Arts & Humanities Council will support the expansion of this project.

Next Steps:

A letter of support will be drafted and provided to the Hyattsville CDC for inclusion in its grant application.

Fiscal Impact:

Not applicable

City Administrator Comments:

Recommend Support.

Community Engagement:

The final designs of the traffic box wraps will be selected by a jury consisting of area residents, City Council members, and local artists. HCDC will market the Traffic Box Art Wrap project through its social media channels, (facebook, twitter, Instagram), and also provide a public page on its website describing the project, providing updates, and community events. The HCDC intends to hold a public ceremony once the art wraps are installed.

Strategic Goals:

Goal 5: Strengthen the City's Identity as a Diverse, Creative, and Welcoming Community

Action 5.4 – Develop and maintain strategic partnerships with organizations and communities

Legal Review Required?

N/A

3/2/2017

Ms. Rhonda Dallas
Executive Director
Prince George's Arts and Humanities Council
Upper Marlboro, MD 20774

Dear Ms. Dallas,

I am writing to express the City of Hyattsville's steadfast support for the Hyattsville Community Development Corporation's (CDC) FY18 County Arts Grants Program. Funding will support the production and installation of artistic vinyl wraps on utility cabinets located in the commercial districts of the city. This project is an expansion of the CDC's traffic box art wrap project which will wrap 22 traffic signal cabinets in Hyattsville in summer, 2017. With funding from PGAHC, the CDC will be able to provide more comprehensive graffiti mitigation and community beautification in our City.

This project addresses the City of Hyattsville's Sustainability Plan by incorporating the arts into our streetscapes improving the physical appearance of our public spaces and removing blight from our commercial corridors.

The City has partnered with the Hyattsville CDC on many past projects and programs, and provides continuing annual coordination and support for the CDC's signature event, the Downtown Hyattsville Arts Festival. We value their efforts to promote revitalization and utilize existing infrastructure to improve the visual landscape of our community.

Thank you for your consideration.

Sincerely,



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: Community & Economic Development

Item Type: Grant

Agenda Section: Consent Items (8:45 p.m. - 8:50 p.m.)

SUBJECT

Hyattsville CDC: Request for Maryland Heritage Area Authority Letter of Support

Motion

146-03-FY17

Recommendation:

I move to authorize the Mayor, on behalf of the City of Hyattsville, to provide a letter of support to the Hyattsville Community Development Corporation for its Maryland Heritage Area Authority grant application.

Sponsor(s):

Hollingsworth, Perry, Ward, Wright

ATTACHMENTS

[Draft COH LOS_CDC MHAA Grant Application.docx](#)

Summary Background:

The Hyattsville Community Development Corporation is producing a grant proposal to the Maryland Heritage Area Authority. This proposal is for the production of an artistically designed, portable, reusable 9 hole mini-golf course thematically focused on Hyattsville's transportation history. This project is specifically outlined in the Anacostia Trails Heritage Area Management Plan and is intended to be used as a creative placemaking initiative to transform underutilized areas throughout the city.

Next Steps:

A letter of support will be drafted and provided to the Hyattsville CDC for inclusion in its grant application.

Fiscal Impact:

Not applicable

City Administrator Comments:

Recommend Support.

Community Engagement:

N/A

Strategic Goals:

Goal 5: Strengthen the City's Identity as a Diverse, Creative, and Welcoming Community

Action 5.4 – Develop and maintain strategic partnerships with organizations and communities

Legal Review Required?

N/A

February 16th, 2017

Mr. Richard Hughes
Administrator, Heritage Area Program
Maryland Historical Trust
100 Community Place
Crownsville, MD 21032

Dear Mr. Hughes,

As Mayor of Hyattsville, I am writing to show steadfast support for the Hyattsville Community Development Corporation's (HCDC) FY 2018 MHAA Grant application to produce an artistically designed mini-golf course thematically focused on transportation heritage in the ATHA region.

The Hyattsville CDC continues to serve as an important project partner in the revitalization of our community. Through this project, HCDC will produce a reusable placemaking resource able to be easily set-up at various underutilized locations in Hyattsville and at heritage events. The mini-golf course will be an inclusive community building activity that allows residents to engage with the heritage history of the ATHA region. Additionally, this project addresses the City of Hyattsville's Sustainability Plan by incorporating the arts into our streetscapes improving our public spaces.

The City has partnered with the Hyattsville CDC on many past projects and programs, and provides continuing annual coordination and support for the CDC's signature event, the Downtown Hyattsville Arts Festival. We value their efforts to promote revitalization and implementing projects that attract the D.C. region to our community.

We are thankful for the opportunity to support this effort and ask that MHAA join us in serving as a partner by supporting the Hyattsville CDC's grant application

Sincerely,



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Laura Reams

Submitting Department: Community & Economic Development

Item Type: Grant

Agenda Section: Consent Items (8:45 p.m. - 8:50 p.m.)

SUBJECT

Anacostia Trails Heritage Area Inc. (ATHA) Request for Preservation Maryland Letter of Support

Motion #

147-03-FY17

Recommendation:

I move to authorize the Mayor, on behalf of the City of Hyattsville, to provide a letter of support to Anacostia Trails Heritage Area Inc. for its Preservation Maryland grant application.

Sponsor(s):

Hollingsworth, Perry, Ward, Wright

ATTACHMENTS

[ATHA support letter.docx](#)

Summary Background:

If awarded, grant funds will be utilized to purchase a projector, iPad and screen for ATHA's workshop/lecture space.

Next Steps:

A letter of support will be drafted and provided to ATHA for inclusion in its grant application.

Fiscal Impact:

Not applicable

City Administrator Comments:

Recommend Support.

Community Engagement:

N/A

Strategic Goals:

Goal 5: Strengthen the City's Identity as a Diverse, Creative, and Welcoming Community

Action 5.4 – Develop and maintain strategic partnerships with organizations and communities

Legal Review Required?

N/A

Preservation Maryland

3600 Clipper Mill Road

Baltimore, MD 21211

Dear Mr. Redding:

I am writing in support of the Anacostia Trails Heritage Area Inc.'s (ATHA's) request for support of their Heritage Center. ATHA has been working for the last few years to expand economic growth in the region through unique heritage-related programs, as well as pushing for increased bike-related tourism and expanding partnerships with municipalities and organizations. They continue to seek a variety of sources of funding to support their work. ATHA has a proven track record of successfully bringing community connections to the region.

The ongoing work of ATHA to provide technical assistance, marketing, partnerships, and local-level funding is critical to creating a strong heritage tourism base for the region. Their work with Prince George's County, Maryland-National Capital Park and Planning Commission, Prince George's Heritage Inc., the Conference and Visitors Bureau, local municipalities, and historic and cultural sites is critical to ensuring that ATHA's program and activity outreach is as widespread as possible, reaching residents and tourists. ATHA has been very effective in their work.

In particular, I support the work of ATHA in the development of their Heritage Center. By funding the development of a technology suite of tools, the space will be more accessible to a wider variety of users. Monthly lectures, workshops, and more will be held in the space. I hope Preservation Maryland will support this work to encourage the growth of historic preservation around the region.

I urge Preservation Maryland to support ATHA's request for these funds.

Sincerely,



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Douglas Holland

Submitting Department: Police Department

Item Type: Budget

Agenda Section: Discussion Items (8:50 p.m. - 9:40 p.m.)

SUBJECT

Mt Rainier's Request for HCPD to Provide Dispatch Services (10 minutes)

Motion

Discussion, Scheduled for Action 3/20/17

Recommendation:

Sponsor(s):

At the Request of the City Administrator

ATTACHMENTS

Summary Background:

Mt. Rainier requested that the City of Hyattsville Police Department assume responsibility for their police dispatch services. Mt. Rainier currently receives dispatch service from Bladensburg. They average 9,000 calls for service a year and have 2-3 officers on duty at any given time.

Mt. Rainier believes they could be better served by Hyattsville and expressed Hyattsville's proximity, responsiveness, customer service, and the potential for reduced costs, as their rationale. They are also aware that Hyattsville transitioned to the new County Computer Aided Dispatch (CAD) System earlier this year and believe would be a benefit to their City and residents. Hyattsville's officers and dispatchers are fully trained on the CAD system and as expected, it is allowing the City access to real time County 911 Calls for Service.

The staff met with the Mayor and Chief of Police in mid February to get more information on their needs and expectations. After evaluating their requirements, the staff believes we can support their request, with two dispatchers on each shift. On occasion, and based on our current staffing levels, we only have one dispatcher on duty during some evening or midnight shifts. If we enter into a partnership with Mt. Rainier, we would require them to cover the cost for one additional dispatcher. This should allow for two dispatchers on duty at all times with rare exceptions.

The salary to hire an additional dispatcher with benefits is approximately \$52,000. The staff gave Mt. Rainier a cost estimate of \$61,000, which they tentatively agreed to. This cost estimate will ensure that we have the flexibility to cover one dispatcher's salary and overtime that may occasionally be required. Bladensburg charges approximately \$72,000 and has been providing support to Mt. Rainier for the past 20 years. Mt. Rainier asked for a 3 year contract with Hyattsville and understands that if approved, they can expect a slight increase each year to cover the cost of merit increases for the additional dispatcher.

Hyattsville currently receives approximately 22,500 calls for service per year and with the recent transition to the CAD system, our process has proven to be more efficient, allowing for improved response times. Based on our analysis of requirements and call for service levels, we believe we can fully support this request without any negative impact to our operations.

Next Steps:

Request approval for the City Administrator to enter into an MOU with Mt Rainier.

Fiscal Impact:

\$61,000

City Administrator Comments:

Recommend Support. This is a good partnership opportunity.

Community Engagement:

N/A

Strategic Goals:

Goal 3 - Promote a Safe and Vibrant Community

Legal Review Required?

Pending



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Joseph Solomon, W5

Submitting Department: Legislative

Item Type: Budget

Agenda Section: Discussion Items (8:50 p.m. - 9:40 p.m.)

SUBJECT

HWRAC FY18 Budget Priority: Hyattsville Welcome Packet (10 minutes)

Motion

Discussion, Action TBD

Recommendation:

I move that Mayor and Council accept the publication and distribution of a Hyattsville Welcome Packet as a Hyattsville budget priority to be funded FY18 Hyattsville municipal budget.

Sponsor(s):

Solomon, Ward, Perry

ATTACHMENTS

[HWRAC Discussion_Welcome Packet_cover.pdf](#)

[Staff_Comments_Welcome_Packet-3-6-17.docx](#)

[City of Romulus Complete Welcome Packet 12.16.pdf](#)

Summary Background:

To provide new residents with easy access to emergency contact information, local services and representatives, and community attractions and events. Packets will include welcome refrigerator magnets.

The committee request 500 printed copies (50 per ward for distribution and another 250 at the city building). The packets at the city building will be mailed on-demand to residents who requested and could not download electronically. Total = 500 color welcomes packets, 250 items for mail, and the committee would handle distribution of 250 packets to local venues in each ward.

See attached samples:

City of Romulus Welcome Packet

City of Greenbelt Welcome Packet

Hyattsville CDC Electronic Packet - <http://hycdc.org/community-building/>

Next Steps:

Once approved the HWRAC committee will work with City staff (and contractors if needed) to prepare and make available a Hyattsville Welcome Packet.

Fiscal Impact:

5,000.00

City Administrator Comments:

The staff can support. The projected cost for 500 copies of an eight-page, full color brochure, stapled, is approximately \$800.

Community Engagement:

Discussed at HWRAC meeting.

Strategic Goals:

Goal 1: Availability of Information

Legal Review Required?

N/A



Memo

To: Mayor and Council
From: Jake Rollow, Community Services Director
CC: Tracey Nicholson, City Administrator
Date: March 6, 2017
Re: Staff Comments on Welcome Packet Proposal

Staff researched potential costs for such a document. The cost of 500 copies of an eight-page, full color brochure, stapled, is about \$800. With this in mind, with \$5,000 the Committee could expand to up to about 40 pages and/or choose to use glossy paper, work with a graphic designer, etc.



CITY OF ROMULUS

LEROY BURCROFF, MAYOR



11111 Wayne Road Romulus MI, 48174
OFFICE 734.942.7571 FAX 734.955.4529

Welcome New Resident!

Congratulations on choosing Romulus as your new home! As a lifelong resident of Romulus, I have served the City in many different capacities and was elected Mayor in 2013. It is a very exciting time in our community. Under my new administration many positive changes have taken place and I look forward with great anticipation to create more opportunities to make our City better.

Since November 2013, my staff and I have enhanced our process for responding to requests from our citizens. We have done this through policy changes and employee development training stressing customer service at all levels. We now have a solutions oriented culture. Our team of dedicated employees work together to deliver outstanding professional services. We have developed an innovative approach to exceed your expectations. There is more work to do but we are excited about the progress so far.

During the past year, we reopened three large neighborhood parks. Elmer Johnson Park (commonly referred to as EJ's) is located at 9700 Ozga Road and is the City's largest park. This park includes a dog park, a regulation size softball field, basketball courts, horseshoe pits, children's playground, an archery range and a large picnic pavilion that is available for rent. Fernandez Park is located on the north end of town near the intersections of Columbus and Avalon Streets. This park has newly resurfaced basketball courts, a children's playground, picnic pavilion and a fitness trail. Oakbrook Neighborhood Park is located on the south end of town near Colbert and Spain Streets. This park has a dog park play area with obstacles and a "dog run" for your canine friends to get some exercise and socialize. The park also has a small pavilion and playground for you and your family to enjoy. The Recreation Department has programs for adults and children alike. I invite you to contact our Recreation Department to find out more about what programs are available. We also have the state of the art Romulus Athletic Center (AKA the RAC) located at 35765 Northline Road.

Please take the time to check out our City website, our community Facebook page and our YouTube Channel (see addresses below). If you subscribe to Comcast, you have access to our government and community channels 12 and 18. We will do our very best to keep you updated and informed. If I, or my staff can be of assistance at any time, please do not hesitate to contact my office at 734.942.7571.

Sincerely,

LeRoy D. Burcroff, Mayor
www.romulusgov.com
City of Romulus

CITY OF ROMULUS

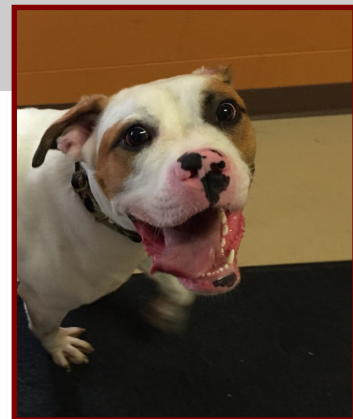
12300 WAYNE ROAD, ROMULUS MI 48174



Romulus Animal Shelter

- **Business Hours 8:00 AM-10:30 AM and 2:30 PM-3:45 PM**
- **Animals at the shelter can be viewed on Facebook and PetFinder (Romulus Animal Shelter)**
- **Cat & Dog adoption \$10 and \$25 deposit to spay/neuter**
- **Domestic Animal adoption also available**
- **Dogs 4 Months or older must have City dog License. Please call for details**

	<u>Spayed/Neutered</u>	<u>Intact</u>
1 Year License	\$3.00	\$7.00
2 Year License	\$5.00	\$12.00
3 Year License	\$8.00	\$15.00
Discounts for Seniors- Please Call for Details		



ANIMAL CONTROL STAFF

Ordinance Director

Bonnie Freeman
734.942.6851

Secretary

734.942.6851
Christine Rohn

Animal Control Officers

734.942.7591
Kim Ratcliff
Annie Hall
Rae Lipkowski



CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Clerk's Office

WELCOME TO THE CITY OF ROMULUS!

It is my pleasure to welcome you to the City of Romulus. I am pleased to provide you with information that I hope you will find beneficial. For your convenience, included in the welcome packet is a voter registration application and voter precinct map:

The Clerk's Office is located in the Lower Level of City Hall. Our hours of operation are Mon-Fri 8:00AM-4:00PM. We are pleased to provide the following services:

- **Public Information**
- **Records Management**
- **Elections Administration (including voter registration, absentee ballot requests, election inspectors' training and precinct assignment)**
- **F.O.I.A. requests (Freedom of Information Act)**
- **Business license registrations**
- **Notary public services**
- **Sale of Romulus Memorial Cemetery plots**
- **Garage/Yard Sale permits**

If we may assist you in any way, please do not hesitate to contact us, we would love to meet you!

IMPORTANT NUMBERS

Clerk's Office
734.942.7540
Fax 734.942.7592

Deputy Clerk
734-955-4544

Elections Clerk
734-955-4541

Business Registrations and Records
734-955-4542

FOIA Requests
734-955-4540



CITY CLERK
ELLEN L. CRAIG-BRAGG, CMC, CMMC

CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Community Services

Community Services Oversees the following:

Cable/Media Department

- Romulus Cable Channels 12 & 18

Recreation Department

- Recreation Programming

Senior Services Department

- Senior Programming/Chore Services
- Meals on Wheels
- Focus Hope Food Distribution

IMPORTANT NUMBERS

Mayor's Office

11111 Wayne Road
734.942.7571
Fax 734.941.2122

Community Services

Jazmine Danci— Director
734.955.4504
Fax 734.941.2122

Media Department

Roger Kadan— Media Director
734.955.4503

Cable Department

Mike Laskaska— Cable Director
734.955.4555

Recreation Department

Tanya Cofield— Recreation Coordinator
734.955.4521

Senior Services Department

Rose Swidan— Senior Services Director
36525 Bibbins
734.955.4120



COMMUNITY SERVICES DIRECTOR
JAZMINE Danci

Keep up to date with all the
news and events!



Like us!

www.facebook.com/CityofRomulus



Watch all of our Cable Programs!

www.youtube.com/user/CityofRomulus

City of Romulus
www.romulusgov.com

CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Economic Development

Economic Development Department is responsible for the following:

- **Retaining and attracting employment opportunities**
- **Encouraging and improving business development**
- **Assist with permits and approvals from other agencies**
- **Administers Tax Increment Finance District (TIFA), Downtown Development District (DDA), Next Michigan Development Corporation (NMDC) and Foreign Trade Zone (FTZ)**

IMPORTANT NUMBERS

Economic Development Office

11111 Wayne Road

734.942.7545

Fax 734.941.5842

Mayor 's Office

11111 Wayne Road

734.942.7571

Fax 734.941.2122



**ECONOMIC DEVELOPMENT DIRECTOR
TIM KEYES**

CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Finance Department

Located inside City Hall on Upper Level

Business Hours Monday through Friday 8:00AM– 4:00PM

Department of Finance: 734.942.4560

- **Finance Department oversees Water utility billing services to over 7,000 Customers**
- **After hour emergencies contact the Police Department 734.941.8400**
- **Includes budgetary, financial reporting and purchasing functions**

Department of Assessment: 734.942.7520

- **Estimates the market value for your home**
- **Property taxes are calculated based on taxable value**
- **City millage rates included in Welcome Packet**
- **New property owners must submit their property transfer affidavits here**

IMPORTANT NUMBERS

Water Utility Billing

734.942.7560

Fax 734.941.3296

Department of Assessment

Director Julie Albert

734.942.7520

Fax 734.941.5853

Purchasing Department

Director Lynn Conway

734.955.4568

Fax 734.955.4123



**DIRECTOR OF FINANCIAL SERVICES
SUZANNE B. MORENO**

CITY OF ROMULUS

11165 OLIVE STREET, ROMULUS MI 48174



Romulus Ordinance Department

- The Ordinance Department is responsible for enforcing many City Ordinances, including Noxious Weeds, Inoperable vehicles and Unkempt premises. The Department processes fingerprints for licensing of entertainers, transient merchants and ice cream vendors in addition to inspections for Taxi Cabs, Ice Cream Trucks and Limousines.
- Depending on the violation, a warning letter or written warning is issued usually given 10 days to comply. Failure to comply will result in a citation being issued which will require a court appearance.
- Please see City Website for a list of ordinances (www.romulusgov.com)
- The Ordinance Department processes hundreds of applicants yearly. In addition, the Department assists the Public Safety, Animal Control, Building & Safety, and the Public Works Departments.

Important Numbers

Ordinance Department

734.942.6851

Emergency (Police & Fire)

9-1-1

Police Department

11165 Olive Street

Non-Emergency (Police)

734.941.8400



Bonnie Freeman, Ordinance Director

CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Planning Department

The Planning Department is located inside City Hall. Our hours of operation are Monday through Friday 8:00am-4:00pm.

We provide assistance and information in the following areas:

- **Development Review Process**
 - **Planning Commission**
 - **Zoning Ordinance/Map**
 - **Master Plan**
 - **Board of Zoning Appeals**
- **Current Development Proposals**
 - **Zoning Verification**
 - **Applications and Forms**
 - **Maps**

IMPORTANT NUMBERS

Planning Department

734.955.4530

Fax 734.941.5842

Email cmaise@ci.romulus.mi.us

Economic Development Department

734.942.7545

Fax 734.941.5842



**CITY PLANNER
CAROL MAISE**

CITY OF ROMULUS

11121 WAYNE ROAD, ROMULUS MI 48174



Romulus Public Library

The Romulus Public Library provides a number of services:

The Romulus Public Library provides a number of services:

Has a collection of over 71,000 books, audio books, CD's, DVD's, newspapers and magazines

Programs and Classes: Book discussions, computer classes, story time and summer reading programs

Copier and Fax Services

Meeting rooms and study spaces

Book sales and fundraising events

Library cards are available to Romulus and Huron residents and those who work in the City

IMPORTANT NUMBERS

Romulus Public Library

11121 Wayne Road

734.942.7589

Fax 734.941.3575

Mayor's Office

11111 Wayne Road

734.942.7571

Fax 734.941.2122



LIBRARY DIRECTOR
PATTY BRADEN

CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Public Safety

Emergency Notifications/Updates

- **Sign up for notification of emergency situations on Code Red (www.romulusgov.com)**

Fire Department

- **Free residential fire safety inspection**
- **Fire prevention education taught in schools**

Police Department

- **Police Department has two liaison officers assigned to the high school and middle school**

Ordinance Department

- **Please see City Website for a list of ordinances (www.romulusgov.com)**

IMPORTANT NUMBERS

Emergency (Police & Fire)

9-1-1

Police Department

11165 Olive Street

Non – Emergency (Police)

734.941.8400

Fire Department #4

28777 Eureka Rd

Non Emergency (Fire)

734.941.8585

Ordinance Department

11165 Olive Street

734-942-6851



PUBLIC SAFETY DIRECTOR
JADIE SETTLES



DEPUTY FIRE CHIEF
KEVIN KRAUSE (L)

FIRE CHIEF
DAVID ALLISON (R)

CITY OF ROMULUS

12600 WAYNE ROAD, ROMULUS MI 48174



Romulus Public Services

Building Department assists with the following:

- Provides, examines and approves plans
- Issues permits
- Conducts inspections
- Issue Certificates of Occupancy
- Contact for building blue prints

Department of Public Works assists with the following:

- Driveway and road permits
- Rubbish, recycling and yard waste removal
- Snow removal
- Street sweeping
- Water and sewer maintenance



DIRECTOR OF PUBLIC SERVICES
BOB MCCRAIGHT

IMPORTANT NUMBERS

Building Department

12600 Wayne Road

734.942.7550

Department of Public Works

12600 Wayne Road

734.942.7579



DIRECTOR OF PUBLIC WORKS
ROBERTO SCAPPATICCI

CITY OF ROMULUS

36525 BIBBINS ROAD, ROMULUS MI 48174



Romulus Senior Services

Services Currently Available at the Center:

- Meals on Wheels daily Monday-Friday
- Congregate hot lunches daily Monday-Friday
- Liquid Supplemental Nutrition monthly
- Surplus Commodities and Focus Hope monthly food distribution
- Transportation for Medical and Personal Appointments
- Transportation for shopping trips to Meijer & Walmart weekly
- Chiropractic Care twice each month
- Hair Cuts once each month
- "Ask the Lawyer" once each month
- Caregiver Support Group and Grief Support Group once each month
- Medicare Part D Counseling
- Special programs when available
- Chore Services for qualified residents
- Two Flu Clinics each year
- Health Fair
- Food Pantry
- Adult underwear/briefs (Diaper Pantry)
- Medical Equipment and supplies pantry
- Blood Pressure checks each month
- Various Health screenings when available
- Educational forums
- Diabetes Seminar
- Health Education
- "Ask the Doctor" each month
- Dine with the Doc
- Spelling Bee
- Healthy Eating and Cooking Classes

Senior Services Department

Rose Swidan— Senior Services Director

36525 Bibbins

734.955.4120

Fax 734.941.7699

Mayor's Office

11111 Wayne Road

734.942.7571

Fax 734.941.2122



SENIOR SERVICES DIRECTOR
ROSE SWIDAN

City of Romulus

www.romulusgov.com

CITY OF ROMULUS

11111 WAYNE ROAD, ROMULUS MI 48174



Romulus Treasurer's Office

The Treasurer's office is located in City Hall. We are open Monday through Friday, 8:00 am – 4:00 pm.

We provide the following services to our residents:

- **Issuance of dog licenses**
- **Processing of water and tax payments**
- **Issuance of dump permits**

Payments can be made in person at our counter, by mail, or by utilizing one of the two drop boxes outside City Hall. Payments can also be made online at

www.officialpayments.com or over the phone by calling 1-800-2-PAY-TAX (a fee applies when using the online or phone option).

Tax info and "real-time" payment activity can be viewed on the City's website www.romulusgov.com.

Property tax notices are mailed each season for receipt on July 1 (Summer) and December 1 (Winter). If you have not received your bill by the second week after they were sent, please contact our office.

TREASURER'S OFFICE

11111 Wayne Road

734.942.7580

Fax 734.941.5541



**CITY TREASURER
STACY PAIGE**

CITY OF ROMULUS

ELMER JOHNSON PARK
9700 OZGA ROAD
ROMULUS MI 48174



Elmer Johnson Park

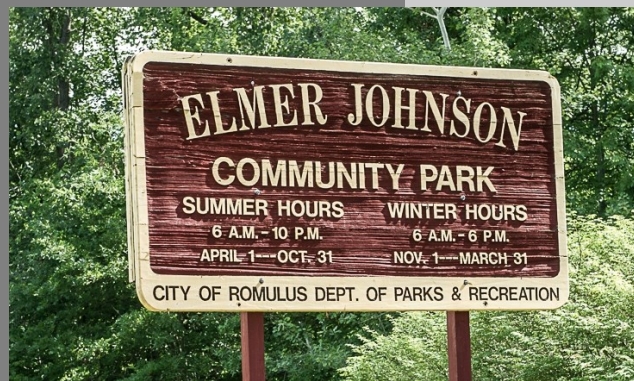
BASKETBALL COURT

HORSE SHOE PIT

BBQ GRILLS

PICNIC PAVILLION

DOG PARK



REGULATION SOFTBALL COURT

SAND VOLLEYBALL COURT

ARCHERY RANGE

PLAYSCAPES



IMPORTANT NUMBERS

PARKS & RECREATION
734.941.8665

MAYOR'S OFFICE
734.942.7571



Contact the Mayor's
Office for Pavillion
Rentals!!!!
734.942.7571

CITY OF ROMULUS

FERNANDEZ PARK
AVALON STREET
ROMULUS MI 48174



Fernandez Park

3 BASKETBALL COURTS

PLAYSCAPES

PICNIC TABLES

PICNIC PAVILLION



CHESS TABLES

PLAYSCAPES

SWING SETS

WALKING PATHS



IMPORTANT NUMBERS

PARKS & RECREATION
734.941.8665

MAYOR 'S OFFICE
734.942.7571



Contact the Mayor's
Office for Pavilion
Rentals!!!!
734.942.7571

CITY OF ROMULUS

HISTORICAL PARK
11147 HUNT STREET
ROMULUS MI 48174



Historical Park

PICNIC PAVILLION



LIGHTS AND
ELECTRICAL OUTLETS



IMPORTANT NUMBERS

PARKS & RECREATION
734.941.8665

MAYOR'S OFFICE
734.942.7571

Contact the Mayor's
Office for Pavilion
Rentals!!!!
734.942.7571

CITY OF ROMULUS

MARY ANN BANKS PARK
37200 GODDARD
ROMULUS MI 48174



Mary Ann Banks Park



PAVILLION, BBQ GRILLS, PLAYSCAPES, ICE RINK (WINTER)

IMPORTANT NUMBERS

PARKS & RECREATION

734.941.8665

MAYOR 'S OFFICE

734.942.7571

Contact the Mayor's
Office for Pavilion
Rentals!!!!
734.942.7571

CITY OF ROMULUS

OAKBROOK NEIGHBORHOOD PARK
COLBERT AND SPAIN STREETS
ROMULUS MI 48174



Oakbrook Neighborhood & Dog Park

PAVILLION

PICNIC TABLE



JUNGLE GYM

SWING SETS

DOG EXERCISE
EQUIPMENT



IMPORTANT NUMBERS

PARKS & RECREATION
734.941.8665

MAYOR 'S OFFICE
734.942.7571



Contact the Mayor's
Office for Pavilion
Rentals!!!!
734.942.7571

CITY OF ROMULUS

ST. JOHN'S LODGE PARK
31800 BEVERLY
ROMULUS MI 48174



St. John's Lodge Park



PAVILLION, BASKETBALL COURT, BASEBALL DIAMOND, PLAYPLACE

IMPORTANT NUMBERS

PARKS & RECREATION

734.941.8665

MAYOR 'S OFFICE

734.942.7571

Contact the Mayor's
Office for Pavilion
Rentals!!!!
734.942.7571



Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Joseph Solomon, W5

Submitting Department: Legislative

Item Type: Budget

Agenda Section: Discussion Items (8:50 p.m. - 9:40 p.m.)

SUBJECT

HWRAC FY18 Budget Priority: Hyattsville Health Assessment (10 minutes)

Motion

Discussion, Action TBD

Recommendation:

I move that the Mayor and Council accept the preparation of a Hyattsville Health Assessment and Action Plan as a City of Hyattsville budget priority to be funded in the FY18 Hyattsville municipal budget.

Sponsor(s):

Solomon, Ward, Perry

ATTACHMENTS

[HWRAC Discussion_Health Assessment_cover.pdf](#)

[Staff_Comments_Health_Assessment-3-6-17.docx](#)

[Sample Health Assessment](#)

[2010 Census Tracts_City Boundary.pdf](#)

Summary Background:

To explore the current health and well being of our community and define goals to help enhance and promote community health and well being. These goals will reflect our understanding of the broad health and well being aspirations of the diverse and dynamic communities throughout the City of Hyattsville. Sample study attached.

The HWRAC intends to partner to collect and compile regional datasets that identify the health condition of the greater Hyattsville region, as well expand the Hyattsville resident satisfaction survey to understand Hyattsville specific health needs. Using both tools, the committee hopes to develop a Hyattsville Health Action Plan that clearly identifies the Communities long term health goals as well provide a published document for resident awareness on local health issues.

Next Steps:

The City will contract with a firm to prepare a Hyattsville's Health Assessment.

Fiscal Impact:

10,000.00

City Administrator Comments:

Please see staff comments attached.

Community Engagement:

Discussed during HWRAC committee meeting.

Strategic Goals:

Goal 3: Public Safety & Quality of Life

Legal Review Required?

N/A



Memo

To: Mayor and Council
From: Jake Rollow, Community Services Director
CC: Tracey Nicholson, City Administrator
Date: March 6, 2017
Re: Staff Comments on Community Health Assessment Proposal

Staff recommends partnering with the Metropolitan Washington Council of Governments, which is conducting a regional assessment in coordination with Virginia Commonwealth University that will include a "Health Community Index that will be calculated using multi-sector, open source datasets and will be geocoded and evaluated at a neighborhood level." MWCOG staff explained data will be broken down to the census tract level, a few of which are within City boundaries, and a few of which overlap boundaries (see attached map). The final assessment will be released in March of 2018, but MWCOG is willing to share the datasets with the City as soon as they are available. All of this will be free for the City.

Additionally, if the committee seeks resident feedback on health issues, such information could be gathered by survey as an additional component of the City's resident satisfaction and quality of life survey. An additional \$10,000 for an expanded survey should be sufficient.



Health & Wellbeing Plan 2013 - 2017

DRAFT

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Mayor's Message

On behalf of Surf Coast Shire Council I am pleased to present the Surf Coast Health and Wellbeing 2013-2017. This plan explores the current health and wellbeing of our community and describes the goals we have set to help enhance and promote community health and wellbeing over the four year life of this Council.

These goals reflect our understanding of the broad health and wellbeing aspirations of the diverse and dynamic communities throughout the municipality. We are committed to delivering on this plan, which has identified three themes as priorities for the next four years:

- Healthy Engaged Communities
- Local Opportunities
- Service Accessibility.

This Surf Coast Shire Health and Wellbeing Plan forms part of the broader G21 Health and Wellbeing Plan which has been developed through a process of collaboration, consultation and engagement with local communities, organisations and regional partners. Together these plans identify a set of shared regional priorities, local priorities and action plans that aim to create environments and systems to support and strengthen the capacity of communities and individuals to achieve better health.

Council is committed to leading the plan and implementing it in partnership with the community, organisations, agencies and other levels of government. Ongoing communication, collaboration and consultation with these important stakeholders will focus around the role each plays in enhancing community health and wellbeing, and how we can all work together to achieve improved local health and wellbeing outcomes.



Cr Libby Coker
Mayor

Executive Summary

Councils play a key role in planning for health and wellbeing across their municipalities. This important function is recognised in both the *Local Government Act 1989* which outlines a council's role in the protection, improvement and promotion of health and wellbeing and the *Victorian Health and Wellbeing Act 2008* through a requirement that councils develop a municipal health and wellbeing plan within 12 months of a general council election.

The Surf Coast Shire Health and Wellbeing Plan is strongly aligned with the Council Plan 2013 - 2017 which provides the strategic direction for how the organisation will work over the next four years.

The plan also acknowledges the Victorian Public Health and Wellbeing Plan 2011-2015, G21 Regional Health and Wellbeing Planning Frameworks, other related strategies across the Surf Coast Shire, and the role they play in health and wellbeing of our communities. This plan does not seek to duplicate the actions in those plans, instead focussing on areas that are supportive of the desired outcomes and evaluating and reporting on health and wellbeing achievements.

The evidence base for the Health and Wellbeing Plan includes and explores data and its meaning across the four environments for health – social, built, natural and economic, as well as the cultural environment. The Surf Coast Shire health and wellbeing data profile compiles the latest population health, Census data and wellbeing indicators and is included as Appendix 2. This data profile informs the snapshot of health and wellbeing issues in the shire.

The shire has many health and wellbeing strengths performing better than averages or benchmarks in the following:

- healthy diet and exercise
- mental health and welfare
- health conditions/disease
- life expectancy
- community safety/crime (but this is changing)
- community engagement/connection – except social networking
- sustainable living
- economic circumstances overall.

There are also some issues of concern where the shire is performing worse than averages or benchmarks in the following:

- alcohol
- children and families in some parts of the shire
- youth
- some health services
- work life balance
- transport
- housing affordability
- community satisfaction
- condition of local streets and footpaths
- emergency management.

The Surf Coast Shire Health and Wellbeing Plan provides a framework for action aimed at improving the health and wellbeing of communities and individuals in the municipality. To assist in understanding community aspiration about health and wellbeing a range of engagement activities as part of the Council planning process and the G21 Health and Wellbeing Planning Program were undertaken.

Broad consultation and review of the evidence about the health and wellbeing risk factors and issues evident in the municipality have enabled the development of three priority areas for action:

- **healthy engaged communities**
- **local opportunities**
- **service accessibility.**

The implementation of the Plan is about putting into practice the actions and objectives identified in the planning process. Council is committed to leading the Plan and implementing it in partnership with the community, organisations and agencies providing services and other levels of government. This involves working together to pursue agreed activities and support capacity building approaches.

Annual monitoring and review of the progress against actions is an important aspect of the implementation. The purpose of the review is to ensure that actions identified in the plan are being implemented satisfactorily and that they remain the best way for Council to invest in health and wellbeing over the life of plan.

Introduction

Councils play a key role in planning for health and wellbeing across their municipalities. This important function is recognised in both the *Local Government Act 1989* which outlines a council's role in the protection, improvement and promotion of health and wellbeing and the *Victorian Health and Wellbeing Act 2008* through a requirement that councils develop a municipal health and wellbeing plan within 12 months of a general council election.

The Surf Coast Shire Health and Wellbeing Plan forms part of the broader G21 Health and Wellbeing Plan which has been developed through a process of collaboration, consultation and engagement with local communities, organisations and regional partners. Together, these plans identify a set of shared regional priorities, local priorities and action plans that aim to create environments and systems to support and strengthen the capacity of communities and individuals to achieve better health.

Policy Context

The Victorian Public Health and Wellbeing Plan 2011 – 2015 has been developed to meet the requirement under Victoria's *Public Health and Wellbeing Act 2008* that a state public health and wellbeing plan be developed every four years. The goal of the plan is to improve the health and wellbeing of all Victorians by engaging communities in prevention, and by strengthening systems for health protection, health promotion and preventive healthcare across all sectors and levels of government. The alignment of municipal public health and wellbeing plans with this state plan is also required under the Act.

The *Victorian Public Health and Wellbeing Act 2008* requires that municipal public health plans are developed with a focus that;

- builds on priority areas evident in the council plan
- is consistent with the municipal strategic statement and other related plans e.g. heatwave plan
- incorporates evidence-based goals and strategies for creating a local community in which people can achieve maximum health;
- specifies how the council will work in partnership with the Department of Health and other agencies undertaking public health initiatives, projects and programs to accomplish the goals and strategies identified in the public health plan
- supports a social model of health.

The social model of health acknowledges that a range of factors beyond the health sector impact on quality of life, including: land-use planning; transport; economic development; employment opportunities; cultural activities and social connections. To support this approach the Victorian Government has established the Environments for Health framework for public health planning, which identifies the multiple determinants of health using four environments– social, economic, natural and built. It promotes the importance of incorporating health planning into whole-of-council planning, and across council departments.

Whilst local government cannot control all the factors that impact on health and wellbeing, the following roles have been identified as relevant to local government health and wellbeing planning:

- creating a vision and goals
- promoting integrated planning, participation and community development
- promoting partnerships and advocacy for local needs
- establishing structures for corporate cooperation
- supporting collaborative approaches to better health with other local level sectors
- plan, fund and provide a wide range of public health programs.

G21 Region Public Health and Wellbeing Planning Project Context

G21 - Geelong Region Alliance (G21) is a formal alliance of government, business and community organisations working together to improve the lives of people within the Geelong region across five municipalities – Colac Otway, Golden Plains, Greater Geelong, Queenscliffe and Surf Coast.

The G21 Region Public Health and Wellbeing Planning (PHWB) project was designed to produce:

- a G21 region wide public health & wellbeing planning framework that would govern the collaborative action in public health & wellbeing across the G21 Region for 2013-17
- both local and regional stakeholder consultation and engagement
- a regional strategy that identified one to three shared priorities for collaborative action and incorporated local action plans for each municipality
- a set of resources and tools to build capacity within Councils for improved population health based planning and partnerships for evidence based service responses.

The planning framework established a set of guiding principles, a planning process and the key elements or enablers required to undertake future public health and wellbeing interventions across the G21 region.

Based on a review of international, national, regional and state exemplars of health & wellbeing planning frameworks, the planning framework encompasses a more strategic approach to identifying the key PHWB priorities across the region. Given the emphasis on collaborative partnerships, the framework provides a platform for development and delivery on key shared priorities.

The regional strategy will identify links to other completed or potential plans addressing issues such as regional growth, public transport and physical activity. It will indicate annual milestones and key indicators, and provide a range of capacity building resources and tools for councils to integrate into their internal professional development programs.

The benefits of this approach for councils were identified as:

- application of a continuous improvement lens for councils to identify whether their responses to local or regional health and wellbeing issues are good, better or best on a continuum of practice and how they might shift practices and outcomes to the next level
- increased joint planning between local and regional partners that addresses more collaboratively the complexities of the health and wellbeing system

- increased evidence based planning available to consider the impact that life-stage, gender, culture, disability, GLBTI and indigenous status has on health and wellbeing experiences and outcomes in local communities within the region
- provision of resources, professional development and training to re-orient planning and service delivery in a more coordinated and integrated manner for each council, based on individual assessment of good, better or best practice for each council.

Surf Coast Shire Policy Context

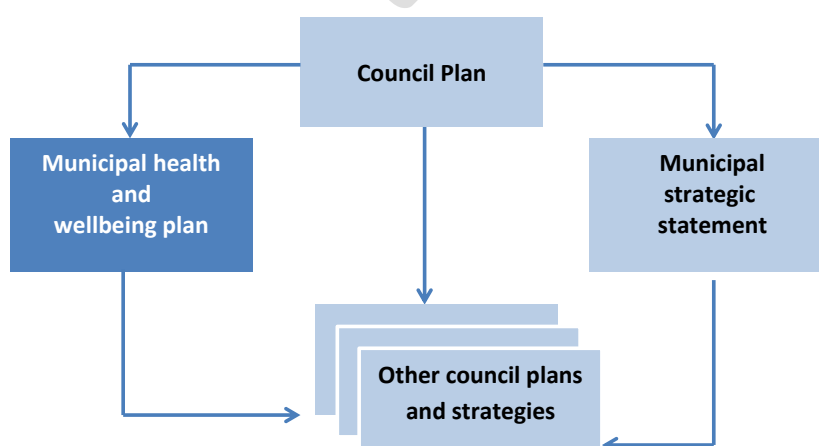
Surf Coast Shire has a range of existing policies and strategies that actively promote municipality-wide health and wellbeing. A complete list is included with the action plan (appendix 1) and includes:

- Surf Coast Shire Council Plan 2013-2017
- Municipal Strategic Statement (Reviewed 2007)
- Heatwave Plan
- Surf Coast Early Years Plan 2009 – 2013
- Positive Ageing Strategy 2008
- Recreation Strategy September 2009
- Community Access and Inclusion Plan 2009-2013
- Open Space Strategy
- Pathways Strategy

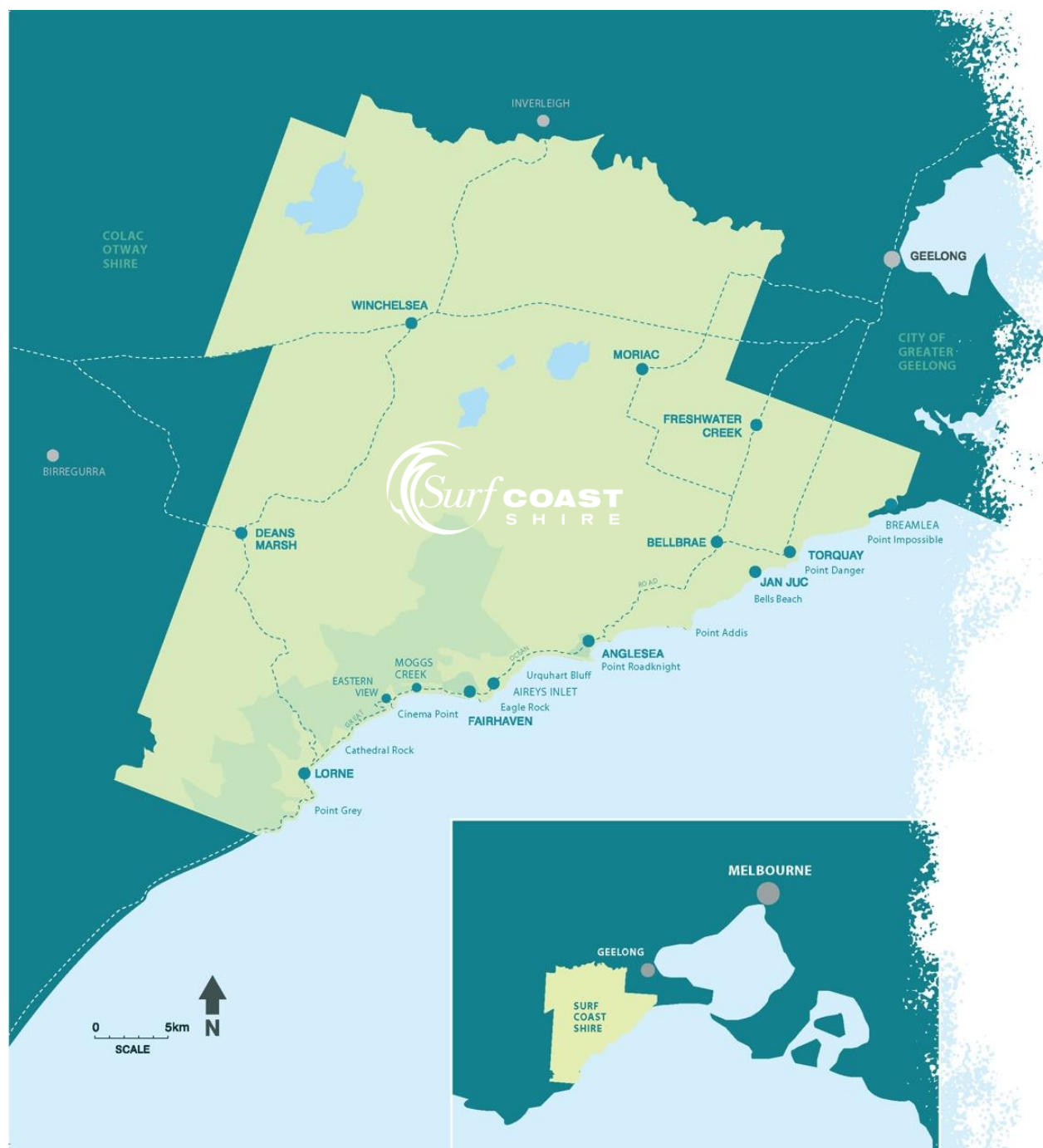
The Surf Coast Shire Health and Wellbeing Plan is strongly aligned with the Council Plan 2013 - 2017 which provides the strategic direction for how the organisation will work over the next four years. The plan also acknowledges existing documents and work across the organisation and the role this plays in health and wellbeing of our communities. Relevant issues identified and prioritised elsewhere include disability access and inclusion, open space access, need for improved public transport, strengthening partnerships with the local aboriginal community, infrastructure allocation and emergency management.

This plan does not seek to duplicate the actions in those plans and work, instead focussing on areas that are supportive of the desired outcomes and evaluating and reporting on health and wellbeing achievements.

Council planning hierarchy



Population Profile



The Surf Coast Shire, with its beach, bushland and rural environment, is located in south-western Victoria, 120km from Melbourne, 21km south of Geelong and close to the extended Geelong Ring Road. The Surf Coast Shire is an appealing destination for holiday makers and international visitors, or those looking to make a permanent sea change.

The Shire is home to nine distinct townships; Aireys Inlet, Anglesea, Deans Marsh, Fairhaven, Jan Juc, Lorne, Moriack, Torquay and Winchelsea. Each of these townships has a keen sense of community, a unique identity and a strong desire to protect and nurture the environment. There is also a significant rural population including farming and rural residential communities.

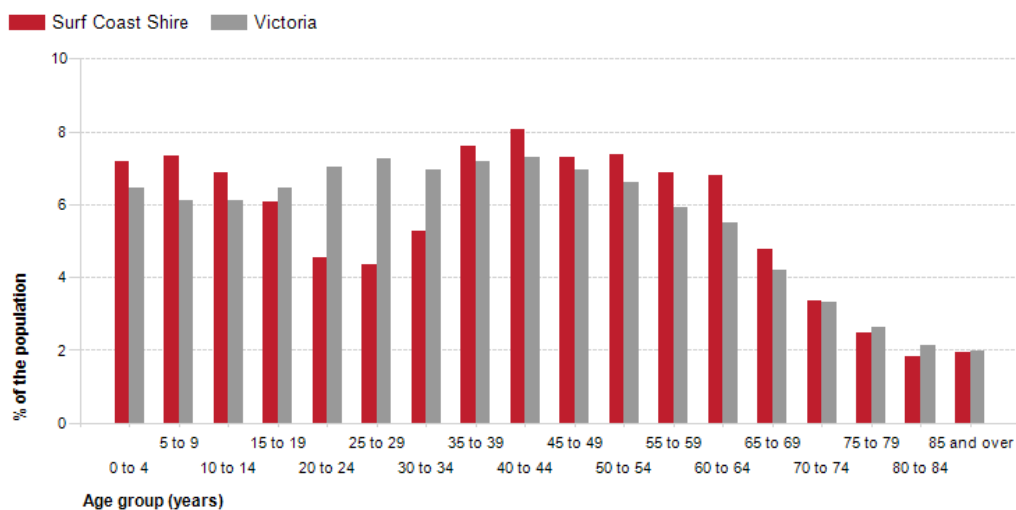
Proximity and lifestyle continue to contribute to the Surf Coast Shire being one the fastest growing municipalities in Victoria. Since 2001 the permanent population of the Surf Coast Shire has grown from 20,872 to 27,167 in 2012 (Estimated Resident Population) and there are about 4,000 additional dwellings, with 16,600 dwellings in 2011. The municipality has over 59% of its property assessments owned by people who do not live permanently within the Surf Coast Shire. On Census night, in August 2011, 42% of private dwellings were unoccupied, reflecting the large number of holiday homes in the shire.

Over the life of the Health and Wellbeing Plan 2013-17 around 4,150 more people are forecast to live in the Surf Coast Shire, taking the population to 32,427 by 2017. Approximately 86% of growth is expected to occur in the townships of Torquay and Jan Juc, with the districts of Moriac and Winchelsea expected to increase by around 5% by 2017. The population is forecast to continue to grow to nearly 45,000 by 2031 (.id Forecast).

While the region's permanent population continues to grow, part time populations are also significant in Surf Coast Shire, including holiday home residents, seasonal visitors, event populations and day trippers. The peak overnight population of Surf Coast Shire between December 2012 and January 2013 was estimated at 83,654 (Economic Indicators Bulletin Geelong 2012).

Surf Coast Shire age structure highlights include a larger than Victorian average proportion of 'primary schoolers' and 'Parents and homebuilders' (35 to 49 year olds), 'Older workers & pre-retirees' and 'Empty nesters and retirees'. There is a smaller proportion of 'tertiary independent' and 'young workforce' (18 -34 year olds). In regional areas this group has a documented pattern of moving to Melbourne for education, employment and social opportunities (profile .id).

Five year age structure, 2011



Source: Australian Bureau of Statistics, Census of Population and Housing, 2011 (Usual residence data)
Compiled and presented in profile.id by .id, the population experts.

.id
the population experts

Health and wellbeing issues – the evidence base

Data profile

The evidence base for the Health and Wellbeing Plan includes and explores data and its meaning across the four environments for health – social, built, natural and economic, as well as the cultural environment. The Surf Coast Shire health and wellbeing data profile compiles the latest population health, Census data and wellbeing indicators and is included as appendix 2. This data profile informs the following summary and snapshot of health and wellbeing issues in the shire. It is important to note that some issues draw on total shire characteristics while others represent indicators from smaller surveys and may require further validation. The currency of the data should also be considered. Where there is a comparison with an average this refers to Victoria.

Summary

The shire has many health and wellbeing strengths performing better than averages or benchmarks in the following:

- healthy diet and exercise
- mental health and welfare
- health conditions/disease
- life expectancy
- community safety/crime (but this is changing)
- community engagement/connection – except social networking
- sustainable living
- economic circumstances overall.

There are also some issues of concern where the shire is performing worse than averages or benchmarks in the following:

- alcohol
- children and families in some parts of the shire
- youth
- some health services
- work life balance
- transport
- housing affordability
- community satisfaction
- condition of local streets and footpaths
- emergency management.

Enabling and risk factors

Key influences on health and wellbeing issues in Surf Coast Shire include the natural environment, accessibility to major centres, gentrification, rapid population and housing growth, tourism and age composition.

Risk and enabling factors of each include the following:

- The proven health and wellbeing benefits of the natural environment mean the shire has an in built advantage to achieving health and wellbeing outcomes for its citizens and visitors. From a quiet walk on the beach, a picnic in the bush, breathing in the fresh air, taking in the rural ambience, surfing in the ocean, to sightseeing down the Great Ocean Road. But with this strength comes the threat of bushfire and associated mental stress, and the need to protect public open space and green belts as the population and dwelling numbers grow.
- Proximity to Geelong (including future Armstrong Creek) and Melbourne enables health and wellbeing through greater choice and access to employment, social, medical and educational opportunities. This proximity, coupled with the coastal lifestyle, attracts many to the shire. The risk is that this may decrease local service provision and disadvantage, for example, those without cars and constrained by limited public transport services.
- The socio economic landscape has changed in recent years, impacted by seachangers migrating from Melbourne. There have been rising house prices, decreases in affordable rentals, a higher proportion of people in the highest income quartile and a lower proportion in the lowest. Surf Coast Shire is one of the least disadvantaged municipalities in Victoria. Although wealthier people tend to be healthier not all health and wellbeing issues follow this trend, including work life balance. This shire-wide result also masks smaller areas of disadvantage. Evidence shows people in the most disadvantaged areas experience lower levels of health and wellbeing across measures of disease, preventative health actions, unhealthy behaviours and ability to participate in the community.
- Community connection is central to health and wellbeing. The shire's rapidly growing permanent population, part time residents and seasonal visitors, provide a wider range of opportunities for connecting than most municipalities. A population risk factor is the large number of permanent population numbers forecast for the shire, placing pressure on a range of services, infrastructure and natural places that contribute to health and wellbeing. Another risk factor is the lower than average permanent population diversity including ethnicity and disability, which may increase feelings of being an outsider for people belonging to these groups.
- The shire contributes to the health and wellbeing of many Victorians, interstaters and people from all around the world as a holiday and day trip destination. This brings a culturally diverse, part time population to the shire. Tourism also provides health and wellbeing benefits to the local community through an increased level of facilities, services, events, employment and recreation opportunities. The risk is that large numbers of visitors may negatively impact on amenity and the environment, including noise and pollution, road congestion and safety, bushfire safety, crime rates and access to services in the summer months.
- The age distribution in the Shire is unusual for a regional municipality, encompassing strong family growth as well as the typical ageing population. This is an enabling factor as generally communities with strong representation in all age groups are able to maintain a broader

range of services and facilities supporting health and wellbeing across the life span. Cross generational support and volunteering is also strengthened. A risk factor is the local variations to this, with smaller coastal towns ageing more rapidly and attracting fewer families, producing pressures for local employment and services. The increase in number of older people generally will impact as health issues may become more acute as people age.

The challenge is to maintain and enhance health and wellbeing strengths and improve weaknesses, in a climate of strong population growth and shifts in the social, built, natural, and economic environments.

Health and wellbeing snapshot

SOCIAL ENVIRONMENT

Health conditions and healthy diet and exercise

Life expectancy in the shire in 2011 is above average and for women at 86.3 years, which is the second highest in the state. This bodes well for the growing number of coastal retirees and the “baby boomer” generation ageing in place. The shire rates well on a number of indicators of healthy diet and exercise. A higher proportion of people met physical activity guidelines, and more people than average visited green space more than once a week. Influences on this may be the beach and surf generating a range of exercise from a peaceful walk on the beach, running coastal steps to surfing. Healthy eating is also a strength with indicators of higher than average fruit and vegetable consumption and lower than average soft drink consumption. Four community gardens in the shire promote community connection and locally grown food. The shire ranks favourably against other local government areas, with indicators of lower rates of disease and obesity, however this still represents 41% of the sample reporting as overweight or obese. Rates of obesity have increased nationally over the past few decades and “halting and reversing this trend is a national priority” (AIHW, 2012a).

Mental health and welfare

“Social problems commonly associated with mental illness include poverty, unemployment or reduced productivity, and homelessness. Those with mental illness often experience problems such as isolation, discrimination and stigma” (AIHW, 2012b). Mental health and welfare indicators in the shire are positive, with subjective wellbeing above average and the number of mental health clients per 1,000 population lower than average in 2010. There was also a lower than average proportion of people reporting in fair or poor health, and levels of psychological stress are similar to average. While society has made progress generally regarding mental health education, mental illness in the community may still go unreported or unrecognised. For example social distance and stigma for those with depression appears to be declining, although it still remains (Beyond Blue, 2013b) and certain groups may be at risk, including new mothers, youth and people with disabilities. There were 136 first time mothers in the shire in 2011-12. Pets can play an important role in positive mental health and the shire has over 6,000 cats and dogs registered in 2013 which represents a high ratio of around one animal to every five people.

Alcohol and drugs

“The consumption of alcohol is widespread within Australia and is entwined with many social and cultural activities. However, excessive use of alcohol leads to substantial health and social harms each year” (AIHW, 2012b). The tourist nature of the shire contributes to a liquor licence outlet density double the regional and state rate in 2009. Drug and alcohol hospital client rates are lower than average, however indicators show a significantly higher than average proportion of people at short-term risk of alcohol related harm and a significantly lower proportion of abstainers. There are also signs of concern relating to alcohol purchase, alcohol related ambulance attendances (particularly in summer), alcohol attributable ambulance admissions for 15-24 year olds and serious road injuries. Drug related offences and ambulance attendances are lower than average. School leaver tourists may impact on some of these measures.

Community safety

Perceptions of safety are high in the shire, with a people feeling safe walking around during the day and night. This is likely to reflect the lower than average crime rates, however this is changing, with crime rates increasing at a faster rate than average. Two crimes of note where rates are similar or exceed average are theft from motor vehicle and behaviour in public (double the average). These trends may link to the tourist and surfing culture, with many cars unattended in public places and a large number of events all year round.

Life stages

Children

The shire has a higher than average proportion of 0-9 year olds (and their parents) mainly due to the strong attraction of Torquay/Jan Juc to families, with its coastal environment, proximity to Geelong and commuting distance to Melbourne. While measures of developmental vulnerability for five year olds for the shire are favourable, this masks local variations.

Youth

While school leavers are a mobile group, the number of young people aged 12 to 24 is on the increase from 3,800 in 2011 to 4,600 by 2017 (.id Consulting, 2013). The proportion of youth studying at TAFE is higher than average and at university lower than average, so cuts to TAFE funding may have a greater impact on outcomes for young people in this shire. While there is a lower proportion than average of disengaged young people (not employed or enrolled in education) this still represented 150 youth in 2011.

Older people

“There is growing consensus that healthy ageing is not only a state but also a process, for example, adapting successfully to life’s circumstances and engaging in health-promoting behaviours” (AIHW, 2012b). In line with national and worldwide trends, the older population 65 years and over is growing. This represents the “baby boomer” generation (born 1945 – 1964) ageing in place as well as traditional city to coast retirees. It may also include family migration, with grandparents moving to be near children and grandchildren. Many older women live alone. The shire has some of the highest rates in the state relating to Home and Community Care clients, including increasing demand from part time populations.

This comparatively time rich demographic impacts positively on volunteer numbers and working later may also be trend as “a 65 year old in 2011 was healthier and better educated than a 65 year old was 30 years ago and there are likely to be more job opportunities, particularly for part time work” (DPCD, 2012). As people age, however “disability and health conditions tend to become more prevalent and complex” (AIHW, 2012b). There are local variations to proportions of older people and Torquay/Jan Juc has a lower proportion of people 65 and over (10%) than Aireys Inlet, Lorne, Anglesea and Winchelsea (around 20%), although it has the largest number.

Access to health services

There are two hospitals in the shire, Lorne Community Hospital and Hesse Rural Health, while Geelong Hospital is the main public hospital attended. Private health insurance is held by a higher than average proportion of people. The geographic implications of the higher than average ratio of general practitioners to population, coupled with a lower ratio of practice clinics to population, needs to be considered. The shire had rates similar to or below average on most Ambulatory Care Sensitive Conditions (ACSC) in 2011-12. ACSCs are those which hospitalisation is thought to be avoidable with the application of public health interventions and early disease management. Admissions for dental conditions are an exception to this. An issue that also emerged in the children's hospital admissions data for the shire. High rates of hospital admissions for ASACs may provide indirect evidence of problems with patient access to primary healthcare, inadequate skills and resources or disconnection with specialist services.

CULTURAL ENVIRONMENT

Social connection

“Belonging to a social network of communication and mutual obligation makes people feel cared for, loved, esteemed and valued. This has a powerful protective effect on health. Supportive relationships may also encourage healthier behaviour patterns” (G21, 2009). In 2011 in the shire 1,900 people lived alone, 6,700 people did not live in the shire five years earlier and 5,000 did not live in townships. Connection may occur across sports, arts, culture, recreation, environmental and social networking activities. Arts were valued by the community, with indicators of a higher than average proportion of people attending arts activities or events and making and creating arts or crafts. The shire also rated well on measures relating to citizen engagement and volunteering. Although the shire had a higher than average rate of internet access at home in 2011, it scored lower than average on the indicator of social networking as a way to organise time with family and friends.

Spirituality

"Spirituality can mean very different things to people but it generally relates to the overarching meaning and values that infuse our lives. For some it is about participation in traditional faith-based communities, for others it might be as simple as how they feel when they walk in the park. Spirituality is an important part of a holistic understanding of health and wellbeing and yet is often under acknowledged because of its intensely private nature” (City of Port Phillip, 2010). The number of people nominating no religion in the 2011 Census was 32%, which is above average and had increased from 27% in 2006. The significant beach/ocean and other natural places in the shire may contribute generally to spiritual health and wellbeing. In particular the shire has many places of Aboriginal cultural heritage significance. “Traditional Aboriginal culture revolved around

relationships to the land. These relationships held physical, emotional, social, spiritual and cultural significance and bore obligations and responsibilities for caring for and sharing of country. These links continue for Aboriginal people today who retain an affinity with all landscapes” (DSE, 2013).

Diversity and inclusion

In the broadest sense diversity refers to differences across many issues including incomes, address, age, households, employment, religion, ethnicity, ability and sexual orientation. Some people may “be excluded from certain community activities simply by virtue of these characteristics” (City of Port Phillip, 2010). Ethnicity, ability and sexual orientation are considered here, while others are discussed elsewhere. Less diversity than average on counts of ethnicity and disability may increase feelings of being an outsider for people belonging to these groups.

“Recent evidence both in Australia and internationally shows that people with disability experience significantly worse health outcomes than the general population” (AIHW, 2012b). For example people with an intellectual disability are more likely to overweight or underweight, have depression, less likely to get married and are less physically active (Department of Health, 2009). Although the proportion of people with a disability in the shire is lower than average it still represents around 850 people. The number of people on a disability support pension is on the increase and, with age being the biggest determinant of disability, this number is expected to increase. In 2011 2,470 people were providing care to a person with a disability, a long term illness or problems related to age. This may include the “sandwich generation” of middle aged people supporting both ageing parents and children due to having children at an older age and increasing lifespans.

The shire’s permanent population is not very culturally diverse with a lower than average proportion of people born overseas and only 3.4% of people speaking another language at home (German and Italian most common) compared with 23.1% in Victoria. Visitor populations (7.6 million people visited the Great Ocean Road region in 2012) however include people from a broad range of cultural backgrounds. Community safety in relation to water and bushfire risk may be impacted by tourists from non-English speaking backgrounds.

While data is not readily available on non-heterosexual people in the shire “A growing body of evidence suggests non-heterosexual people experience anxiety and depression at higher rates than their heterosexual peers and are at greater risk of suicide and self-harm. Yet there is little recognition of the implications of this for policy and practice” (Beyond Blue, 2013b).

Aboriginal people and Torres Strait Islander people

The largest health inequality between people within a country anywhere in the world exists in Australia. Compared to non-indigenous Australians, indigenous Australians experience a significantly lower life expectancy, and higher levels of disease and disability. The health gap is largely due to unequal access to resources and opportunities necessary for good health, such as income, quality housing, education and participation in community activities (VicHealth, 2012). The 2011 Census reported 147 identified Aboriginal people and Torres Strait Islander people in the shire (0.6% of the population), increasing from 78 in 2006 (0.4%). Health characteristics and outcomes for indigenous Australian residents in the shire are not readily available.

Work Life balance

Despite many strong indicators of health and wellbeing Surf Coast Shire ranks 56th of all local government areas (LGAs) on work-life balance. This may be impacted by the sea change movement boosting the number of people commuting to Melbourne for work. Many make a decision to move to the attractive coastal environment based on lifestyle rather than economy but ultimately a long job commute may impact on lifestyle. While 70% of jobs in the shire are filled by local residents, 5,971 people commute outside the shire for work.

BUILT ENVIRONMENT

Housing

A diversity of housing, with units, flats and separate dwellings, means that people can live sustainably and appropriately to their stage of life cycle. As the population ages, if smaller dwellings aren't available many households may become "empty nesters" living in houses that may be better suited to families. The shire had 13% medium and high density housing in 2011 below the average of 23% for the state. In August 2011 42% of private dwellings were unoccupied, indicating the high number of holiday houses. These dwellings provide the opportunity for a regular getaway from the city for part time residents, contributing positively to their health and wellbeing. The 2,315 new dwellings forecast between 2013 and 2017 presents the challenge of sustainable development. It will provide many with the opportunity to live in Surf Coast Shire and increase their wellbeing - particularly those moving from the city and seeking a sea change, and coastal retirees. Some may convert their holiday homes to permanent dwellings. Others may feel their wellbeing impacted by an increasingly urban environment.

Transport

"The settlements are highly car dependent communities with limited public transport" in the shire (Surf Coast Shire Planning Scheme). Data reflects this statement, with a lower than average proportion of people taking public transport to work, reflecting issues of frequency of service, number of routes and modes available. In 2011, 380 people caught public transport to work compared with 8,511 who drove in private vehicles. Nearly every household has a car, with the third lowest result for the State for households with no vehicle (3.1% or 296 households). Car ownership can be seen as a measure of advantage or disadvantage. The shire's high car ownership increases the ability for people to access services and employment, however it also contributes to increased pollution and congestion and impacts on people's propensity to walk and cycle. For those in the no car minority getting around and accessing services is more challenging than for people without cars in heavily public transport serviced areas of Melbourne.

Safety in design

Feeling safe walking around at night is an indicator the shire rates well above average on (88.7% compared with a 70.3% average) and is similar to average for walking around during the day. Designing for safety "can increase community usage of public spaces day and night, achieve connection and integration of streets and public places, reduce opportunities for crime and anti-social behaviour and improve the quality of life for the community by improving perceptions of

public places” (DPCD, 2005). Road safety measures such as speed reduction measures can improve community safety.

Community infrastructure

This provides opportunities to improve physical and mental health and wellbeing. Council facilities and buildings include indoor and outdoor sports facilities, sporting pavilions, community houses, civic building, library, public halls, swimming pools, senior citizen centres, maternal child health centres, childcare centres and kindergartens. The Community Satisfaction Survey 2013 said the best thing about Council was the recreation/sporting facilities. Urban design including public use facilities such as public toilets, picnic tables, benches and seats, BBQs, shade structures and lighting increase opportunities for the community to rest, recreate, converse and connect.

Urban Design

Urban design can increase opportunities for physical activity and community connection. For new development areas, planning higher density, mixed-use planning components, community hubs, meeting spaces and public plaza spaces may contribute.

The built environment can further promote increased physical activity and community connection through connected walking and cycling paths and transit oriented development. The shire had a lower than average proportion of people who walked or rode a bike to work in 2011, however this was still 438 people. The Community Satisfaction Survey 2013 raised concerns over local streets and footpaths (DPCD, 2013). The shire rated above average on the indicator ‘It’s a pleasant environment, nice streets, well planned, open spaces” in 2008.

NATURAL ENVIRONMENT

Open space

The natural environment is a defining feature of Surf Coast Shire. From spectacular rugged coastlines to dense native forests and rolling plains, the shire is strongly influenced by physical and natural features. This gives the shire a natural health and wellbeing advantage over its urban counterparts, with research showing viewing and being in nature, restorative settings, leisure and recreation, gardens including community gardens, incidental exposure to plants and observing wildlife, contributing to health and wellbeing (Surf Coast Shire, 2004). Not surprisingly the shire is the 3rd highest ranked municipality in Victoria for the indicator for people visiting a green space. And the coast is highly valued by the community, with the beach/foreshore/waterfront the 4th highest response to the best thing about Council, in the Community Satisfaction Survey 2013, Surf Coast Shire (DPCD 2013).

Climate change and bushfires

Climate change has brought with it awareness of new challenges such as access to water, rising sea levels and exposure to increased severity and frequency of natural disasters.

The high bushfire risk in Victoria is a consequence of a number of factors, including vegetation, topography, climate and population patterns, which show population density increasing in bushfire prone areas, like Surf Coast Shire (Surf Coast Shire, 2012). In the Community Satisfaction Survey

2013, emergency disaster and management was noted as the most important of 15 council services surveyed. The community may be experiencing mental stress about bushfires, especially members of vulnerable communities such as the frail elderly in Lorne, Aireys Inlet-Fairhaven and Anglesea.

Sustainable Living

People may increase their own wellbeing by looking after the wellbeing of the planet as well as improving the environment for future generations. There is an increasing environmental awareness in the shire with increased expectation of waste management practices. Indicators report a higher than average proportion of households recycling waste and collecting wastewater. The shire's community gardens and farmers markets provide opportunities for local food production and consumption, reducing "food miles" and increased healthy eating.

Environmental Health

Residential amenity issues such as noise pollution may impact on health and wellbeing. Some 97% of noise complaints were resolved in 2012. With the strong hospitality sector 350 food premises were inspected in 2012 with a 6% rate of food related complaints to number of premises. The shire is similar to average for the proportion of children fully immunised at 24-27 months.

ECONOMIC ENVIRONMENT

Socioeconomic factors

Socioeconomic factors including education, occupation and income, are well established as determinants of health, with the socioeconomic gradient of health identifying that "those at higher rungs of the ladder tending to be healthier than those in the middle who, in turn, are healthier than those below". The causal relation between the two however "can be unclear, with poor health due to illness or injury leading to socioeconomic disadvantage in some cases" (AIHW, 2012b).

Local job opportunities

Tourism, hospitality and trades employ around 30% of working residents and many of these work within the shire. As there were more workers (12,488) than jobs (7,150) in Surf Coast Shire in 2011 however, not everyone could be employed locally. Half of the employed people living in the shire commuted outside the shire for work and accessibility to Geelong and Melbourne influence this. Some may choose to do this due to lack of local opportunities in their occupation and many sea changers may already have established employment in Melbourne. Working locally has favourable impacts on commuting time and may potentially increase time for family and work life balance. Post-modern society has brought a wider variety of work and leisure options and Surf Coast Shire has a higher than average proportion working from home (976 people). This may be influenced by seachangers working remotely and the higher than average proportion of homes with internet connection. There was a higher than average proportion of managers and professionals in the shire and a lower than average unemployment rate of 3.5% in 2011.

Income and education

Median household income in 2011 was slightly higher than average. Surf Coast Shire was ranked 24th amongst other local government areas for median household income, and 71st for proportions of people earning less than \$400. Over the last decade there has been an increase in the proportion of people in the top income quartile and a decrease in the proportion in the lowest income quartile. Local variations to this exist. Lorne township had 32% of households in the lowest income quartile (22% for the shire) and only 15% in the highest income quartile (26% for shire). This reflects in part the higher proportion than shire average of part time jobs and a lower proportion of full time jobs. Winchelsea had 34% in the lowest and 11% in the highest quartile.

Surf Coast Shire has experienced an increase in the proportion of students completing Year 12, from 44.7% in 2006 to 50.4% in 2011, compared to the G21 Region with 41.5. The proportion of residents who have post-school qualifications has also increased from 47% in 2006 to 54.3% in 2011.

Housing Affordability

House prices have increased significantly over last decade, with a higher than average median house price of \$577,500 in 2011, but there are local variations. Winchelsea's median price is below the regional Victorian average. Lorne has the highest median price in the shire (a health and wellbeing issue when coupled with the lower than average incomes) and around 74% holiday houses. Many who grow up in the shire's coastal towns may not be able to afford to bring their own families up in the same place. This is a common experience in Melbourne and people generally go to the next suburb out which is cheaper. This is played out differently in regional areas where the next affordable place may be some distance away and may impact on family connectedness and support.

There has been a decrease in rentals in the shire affordable for people on a low income, from around 50% of rentals in 2004 to 15% in 2011. This may gradually force people on low incomes out of the shire and attract those on higher incomes as evidenced by the household income quartile trends. Surf Coast Shire has a lower than average percentage of social housing with 80 dwellings or 0.6 % of the housing stock, compared with a state average of 3.8%.

Disadvantage

Surf Coast Shire is one of the least disadvantaged municipalities in Victoria, and was ranked 74th amongst the seventy nine other local government areas, using the SEIFA (socio-economic indexes for areas) index of disadvantage. But this masks local variations. The score for Winchelsea township comes in just above the score of the 5th most disadvantaged municipality in Victoria. The towns ranked by the SEIFA index and including regional and State benchmarks are: Winchelsea (936), G21 Region (1007) Victoria (1009) Lorne (1041), Anglesea (1048), Aireys Inlet-Fairhaven- Moggs Creek (1056), Surf Coast Shire (1067), Torquay (1077) and Jan Juc (1098). SEIFA is "a good place to start to get a general view of the relative level of disadvantage in one area compared with other". It is derived from Census characteristics such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations "but it is important to look at these underlying characteristics as they can differ markedly between areas with similar SEIFA scores" (Profile .id). Evidence shows people in the most disadvantaged areas experience lower levels of health and wellbeing across measures of disease, preventative health actions, unhealthy behaviours and ability to participate in the community (ABS, 1999).

Community Engagement and Planning

The Surf Coast Shire Health and Wellbeing Plan provides a framework for action aimed at improving the health and wellbeing of communities and individuals in the municipality. To assist in understanding community aspiration about health and wellbeing, a range of engagement activities as part of the council planning process and the G21 Health and Wellbeing Planning Program were undertaken.

In developing the Council Plan a number of community meetings and listening posts were held across the municipality, where community members were invited to provide feedback to the priority areas and strategies proposed for the four year Council Plan. Concurrent to the meetings was an online survey which invited individual input to the plans priority areas rating the both the performance and importance of the themes. A series of health and wellbeing specific questions were also included. The priority areas within the Council Plan have a strong relationship with the health and wellbeing of our local communities when considered under the Environments for Health Framework. Feedback gathered throughout these processes has informed the identification of priority areas for the Surf Coast Shire Health and Wellbeing Plan.

Surf Coast Shire Council Plan 2013-2017 Themes

- Theme 1: sustainable and protected natural environments
- Theme 2: inclusive and accountable governance
- Theme 3: healthy, resilient, safe communities
- Theme 4: community focused infrastructure services
- Theme5: sustainable development and growth.

Participation rates for Council plan engagement activities are:

- number of surveys completed: 135
- number of public workshops held: 6
- number of workshop participants: 103
- number of listening posts held: 7
- number of comments received: 1,151.

Other engagement activities which supported the development of the Health and Wellbeing Plans included a stakeholder concept mapping workshop and Local and Regional Health and Wellbeing Plan Engagement.

The draft Health and Wellbeing Plan 2013-2017 was on Public Exhibition in August 2013. Feedback received has been considered in the preparation of this plan.

Priority Areas for Action

The health and wellbeing of individuals and communities is influenced by many things. These include the places, in which people live, learn, work and play. Through a process of engagement with communities and key stakeholders, a range of themes (Table 1) was identified that could be considered for action. In reaching agreement on the priority areas for action to be progressed in this plan deliberation centred on both the input from our community, and stakeholders and an analysis of what the evidence is telling us about the health and wellbeing risk factors and issues for

our communities (Appendix 2). These processes enabled the development of 3 priority areas for action;

- **healthy, engaged communities**
- **local opportunities**
- **service accessibility.**

Table 1 Stakeholder health and wellbeing priorities

Key stakeholder consultation emerging themes	Council plan survey emerging health and wellbeing themes
• healthy engaged communities ○ healthy lifestyles ○ preventing obesity • access to services for rural communities ○ child care ○ health services • local opportunities ○ education and employment ○ social services	• access to medical and health services • older people – services and nursing homes • children – services and childcare facilities • community connection – preventing social isolation • support for arts and culture activities • mental health and welfare support • transport • accessible walking and cycling paths • recreation facilities • open space

Implementation

The implementation of the Plan is about putting into practice the actions and objectives identified in the planning process. This will involve collaboration with our partner agencies, stakeholders and the community to pursue agreed activities and support capacity building approaches.

Each theme in the Health and Wellbeing Plan is underpinned by a number of objectives. Each objective has a number of outcomes, measures and strategies that detail the agreed priorities to focus on over the next four years.

In addition to the above, the action plan section also identifies the services Council already delivers in support of the themes, the existing council strategies and the key legislation that sets the requirements and direction for Council when fulfilling its commitments to the community.

Council is committed to leading the Plan and implementing it in partnership with the community, organisations and agencies providing services and other levels of government. Ongoing communication and collaboration consultation with service providers, local organisations, state and federal government departments will focus around the role each plays in enhancing the health and wellbeing of the community, and how we can all work together to achieve improved local health and wellbeing outcomes.

Monitoring and Evaluation

It is a requirement of the *Public Health and Wellbeing Act* that all municipal public health and wellbeing plans be reviewed annually. Annual monitoring and review of the progress against actions is an important aspect of their implementation. The purpose of the review is to ensure that actions identified in the plan are being implemented satisfactorily and that they remain the best way for Council to invest in health and wellbeing over the life of plan.

Council is committed to measuring its performance against these themes and has incorporated how each theme is to be measured within this Plan.

The annual review also offers an opportunity to celebrate the achievements of the plan, inform other related plans and policies, strengthen networks and partnerships and inform resource allocation (Department of Health 2012).

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Note: Other data sources are detailed in Appendix 2.

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Appendices

Appendix 1: Health and Wellbeing Action Plan

Current service provision	Current strategic documents	Links to Council Plan
• environment and open space • waste management • community development • arts and culture • early years • positive ageing • environmental health • municipal and emergency management • recreation • planning & development • economic development • tourism • engineering services	➤ Climate Change Strategy ➤ Environment Management Strategy ➤ Open Space Strategy ➤ Arts and Culture Strategy ➤ Community Access and Inclusion Plan 2009 – 2013 ➤ Community Fire Safety Strategy (2006) ➤ Events Strategy ➤ Surf Coast Early Years Plan 2009- 2013 ➤ Heatwave Strategy ➤ Playground Strategy ➤ Positive Ageing Strategy (2009) ➤ Recreation Strategy ➤ Volunteer Engagement Strategy ➤ Municipal Emergency Management Plan ➤ Municipal Fire Management Plan ➤ Municipal Strategic Statement ➤ Economic Development and ➤ Tourism Strategy ➤ Tourism Strategic Plan ➤ Various structure plans, neighbourhood character studies and land use policy studies adopted by Council ➤ Pathways Strategy ➤ Road Safety Strategy (2010) ➤ Youth Strategy	Surf Coast Shire Council Vision: “Working towards an engaged, innovative and sustainable community” The Council Plan identifies five main themes that will guide Council’s focus over the next four years: Environment We pursue innovative and sustainable practices that will preserve and enhance our natural environment for all, by being socially responsible and environmentally aware. Governance We are committed to delivering a transparent, high performing and sustainable organisation that engages with the community and adopts robust risk management practices. Communities We actively engage with our diverse and growing communities to establish quality services, healthy and safe environments and long term community partnerships. Infrastructure We are committed to understanding and meeting our community’s needs for accessible, well maintained and safe infrastructure. Development and Growth We foster healthy and sustainable communities by supporting tourism and rural businesses, and encouraging clean industries and development that respects the Surf Coast’s environment and lifestyle.

Objectives	Outcome (What does this look like? What results do we want to see)	Measure (How you can measure our performance / What we can measure to provide evidence of the outcome)	Strategies (What we will do)	Partners (Other key stakeholders)
1. Healthy and Engaged Communities				
1.1. To build organisational capacity to plan, lead, deliver and evaluate population health and wellbeing outcomes.	Staff demonstrate understanding of the relationship of their role to the health and wellbeing of the community	Number of staff participating in online training module Inclusion of health and wellbeing measures in planning processes	1.1.1. Assess organisation level of capability and readiness 1.1.2. Implement learning and development tools including e-learning and mentoring opportunities across the organisation	G21 The Drawing Board
1.2. To increase participation in physical activities	Increased number of residents involved in physical activity Strong partnerships to create better sport and active recreation opportunities. Safe, inclusive and accessible environments for physical activity. Lower incidence of disease in the community.	Maintain and improve physical activity indicators on the Victorian Population Health Survey and VicHealth indicators. Increase number/proportion of people walking or cycling to work by Census 2016 Participation in G21 Sport and Recreation Pillar, Physical Activity Strategy. Enrolment/usage numbers at Council recreational facilities that promote physical activity. Increased length of pathways constructed across the shire	1.2.1. Identify and progress relevant recommendations in the Recreation Strategy. 1.2.2. Maximise use of Council's recreational facilities through a partnerships approach. 1.2.3. Develop a program to introduce new sport and recreational opportunities for informal/social use. 1.2.4. Promote active transport options and open space settings for physical activity. 1.2.5. Council Plan strategy 4.3.5 Review/update current pathways/cycling strategy.	State based agencies/authorities. National and State based sporting organisations. Local Sporting Clubs Leisure Networks Schools Community Groups Section 86 Committees

Objectives	Outcome (What does this look like? What results do we want to see)	Measure (How you can measure our performance / What we can measure to provide evidence of the outcome)	Strategies (What we will do)	Partners (Other key stakeholders)
1.3. To enhance mental health and wellbeing	A community where mental health is understood talked about and supported. Lower incidence of mental illness in the community.	Improved outcomes on Victorian Population Health Survey psychological distress indicator Number of Mental Health Programs supported.	1.3.1. Review Access and Inclusion Plan Action 3.7 "Support the work of local networks that promote mental health and wellbeing". 1.3.2. Promote the mental health benefits of increased participation in physical activity. 1.3.3. Continue to enhance Community Grants program to support positive mental health outcomes. 1.3.4. Involvement in Mental Health Awareness week. 1.3.5. Enhancing access to open space	Department of Health Local GPs/Medical Centres. Headspace
1.4. To create a shared responsibility around alcohol harm minimisation	Community groups, clubs and individuals are better informed about responsible use of alcohol Safe drinking culture is promoted within the community	Number of community groups with alcohol harm minimisation and responsible serving of alcohol policies Improved outcomes on alcohol related health and wellbeing measures. Number/proportion of Local Law fines Number of sporting clubs	1.4.1. Development of a Council liquor licensing policy across community groups and clubs 1.4.2. Promote Local Law relating to alcohol in public places 1.4.3. Continue harm minimisation approach to School leavers and events 1.4.4. Assess the ability to control the cumulative impact of the number of licenced venues through the Surf	Australian Drug Foundation Leisure networks VicHealth Victoria Police. School Leavers Working Group Barwon Regional Drug Action Plan group CIAC Community Groups/Clubs responsible for

Objectives	Outcome (What does this look like? What results do we want to see)	Measure (How you can measure our performance / What we can measure to provide evidence of the outcome)	Strategies (What we will do)	Partners (Other key stakeholders)
		who participate in the "Good Sports" Program.	Coast Planning Scheme	licensed premises and events.
1.5. To promote sustainable living	Residents are active participants in environmental sustainability activities Council is working with the community to reduce emissions, explore alternative energy opportunities and adapt to a changing climate Council supports and promotes food security initiatives. Promotes small acreage farming Promotes farmers markets	Increased percentage of waste recycled Number of actions delivered in Council's nature reserve action plans Number of Council partnerships with community groups to explore alternative energy options. The number of community gardens in the Surf Coast Shire Activity at community garden food swaps Attendance/ sales at farmers market Local eateries advertising "local sourced foods"	1.5.1. Continue to promote reduce, re-use and recycle messages as part of Councils litter task force 1.5.2. Support community programs that aim to make solar power accessible and cost-effective for residents and businesses 1.5.3. Develop initiatives with community groups to enhance food security and reduce food miles	Community Government organisations

2. Local Opportunities

2.1. Understand changing community demographics	An evidence base that informs health and wellbeing planning and service & program development. Staff are informed and include evidence in planning	Surf Coast Shire Health and Wellbeing data profile is utilised in planning, service and program development. Number of staff participating in educational opportunities	2.1.1. Develop Surf Coast Shire Health and Wellbeing data profile. Publish, promote and update regularly. 2.1.2. Develop Local area township Health and Wellbeing data profiles 2.1.3. Explore impacts of part time populations 2.1.4. Build organisational and workforce capacity to understand and interpret community demographic information 2.1.5. Investigate ways to increase the community involvement of non-resident rate payers. 2.1.6. Explore ways to assess the health and wellbeing impact of local employment strategies.	G21 Department of Health Medicare Local Deakin University
2.2. Build community and organisational capacity to achieve better outcomes for children	Children have access to quality education and care in both formal and informal settings. Staff use AEDI data for planning interventions to support outcomes for children	Children are performing better in developmental areas of the AEDI Number of consultations held in local communities Annual survey of families Revised Early Years Plan has been developed Higher percentage of children fully immunised against state and national averages	2.2.1. Analyse AEDI data to understand local issues 2.2.2. Build organisational and workforce capacity and understanding of the data 2.2.3. Engage with the local community and key service providers to identify priority areas for improvement 2.2.4. Continue to provide childhood and school immunisation program and investigate strategies to improve immunisation rates. 2.2.5. Review and update the Early Years	DEECD Schools and Preschools Community Groups Glastonbury Health Services

			Plan 2009-2013. Implement priority actions.	
2.3. Build community and organisational capacity to achieve better outcomes for youth.	Youth are engaged in employment, education and community activities. Youth have high levels of physical and mental wellbeing.	Number of groups available for youth. Decreased number/proportion of young people not studying or working by Census 2016.	2.3.1. Review and update the Youth Strategy 2009-2013. Implement priority actions. 2.3.2. Investigate the feasibility of shared traineeships and work placements in partnership with key agencies	DEECD Schools Headspace Health services
2.4. Build community and organisational capacity to achieve better outcomes for older people	Older people adjust well to retirement and are valued members of the community.	Number of older people involved in volunteering Number of ongoing projects under the improving livability for older people banner Number of older people using open space	2.4.1. Explore links with volunteer programs to encourage positive interaction across different age groups. 2.4.2. Review and update the Positive Ageing Strategy 2009-2013. Implement priority actions. 2.4.1. Evaluate the Improving Liveability for Older People Project and support future initiatives	Department of Health Volunteer Agencies Schools Community Groups
3. Service Accessibility				
3.1. Ensure equitable access for all to health and community services.	Residents have access to appropriate and timely services that support health and wellbeing. Community services maps available.	Number of people on waiting lists for services Additional / New places created in services Service map identifies location and number of services	3.1.1. Council Plan strategies under Objective 3.2. Quality assessment ratings for aged and family services including assessment of service need and service mapping. 3.1.2. Utilise community demographics and health and wellbeing profiles to	Child care providers. Lorne Hospital Hesse Rural Health Barwon Health Medicare Local

		available across the shire	assist in determining service needs. 3.1.3. Investigate partnerships with Deakin University for township research. 3.1.4. Continue to develop best practice service provision for Council's direct client services including child care, pre-school, M&CH, immunisation services and Home care services. 3.1.5. Explore opportunities for collaborative practice and partnership arrangements for service planning and delivery with other key local service providers 3.1.6. Strengthen Health Care Referral Networks.	State based Health agencies/authorities G21 Deakin University
3.2. Understand rural communities service needs and provision requirements	Reference groups are engaging and participatory opportunities for the community Rural residents are actively represented	Participation rates and vacancies in available services Number of reference group meetings	3.2.1. Establish reference groups for rural communities to assist in determining service need 3.2.2. Utilise community demographics and health and wellbeing profiles to assist in determining service needs 3.2.3. Need to assess and reallocate resources- redevelop strategy- 3.2.4. Links to Council Plan:3.2 Quality assessment ratings for aged and	Hesse Rural Health Lorne Community Hospital Community Houses

			family services including assessment of service need and service mapping	
3.3. Respond to the needs of those living in socio-economic disadvantage	Improved outcomes for disadvantaged people	Increase in the number of social services for Winchelsea	3.3.1. Utilise community demographics and health and wellbeing profile data for Winchelsea. 3.3.2. Develop a Service Plan for Winchelsea Township to address social disadvantage.	Community sector/regional/State based Health agencies/authorities
3.4. Planning for and maximising use of infrastructure for health and wellbeing outcomes	Infrastructure use reaches its potential. A built environment that encourages people to participate in community life.	Infrastructure map identifies location and number of facilities available across the shire Hours of use, number of people and range of activities using Council facilities. Number of community spaces identified in Structure Plans and delivered.	3.4.1. Council Plan Strategy 4.1.1 Perform an infrastructure needs assessment to provide clarity to the community on how a fair distribution of infrastructure will be achieved. 3.4.2. Policy development around multi-use spaces and integrated service provision. 3.4.3. Council Plan Objective 4.2 Accessible well maintained and utilised Council facilities. 3.4.4. Utilise Structure Plans to maximise opportunities to provide meeting spaces, public plaza spaces, community hubs and mixed-use facilities.	Community sector health agencies Regional and State based Health agencies/authorities Property Developers

DATA PROFILE Draft Surf Coast Shire Health and Wellbeing Plan July 2013

			SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
Issue		Indicator	Number	%					
Social Environment									
1. Healthy diet and exercise		People who met physical activity guidelines		69.8%	63.9%		2011-2012		10
		Sedentary behaviour (sitting ≥7 hours per day)		28.0%	32.6%	36	2011		19
		Participation in organised sport		55.0%	42.7%		2008		12
		Visit to green space (≥ once per week)		74.7%	50.7%	3	2011		19
		Easy access to recreational and leisure facilities		78.3%	78.8%		2008		12
		People who did not consume minimum number of serves of fruit or vegetables daily		44.6%	51.1%		2011-2012		10
		Daily soft drink consumption		7.8%	12.4%	73	2011		19
		People who ran out of food in last 12 months and could not afford to buy more.		5.4%	5.6%	43	2008		10
2. Mental health and welfare		Subjective wellbeing Index		80.2%	77.5%		2011		19
		Registered mental health clients per 1,000 population	5.3		10.3	77	2010		9
		Persons reporting a low degree of psychological distress		65.2%	64.6%		2011-2012		10
		Self reported health excellent or very good		54.6%	46.6%		2011-2012		10
		Percentage of persons reporting fair or poor health		10.0%	15.9%		2011-2012		10
		Gaming machine losses per head of adult population	\$176		\$602	64	2011-2012		9
3. Pressure of modern life		Inadequate sleep (less than 7 hrs)		26.3%	31.5%	66	2011		19
		Lack of time/family and friends		30.3%	27.4%		2011		19
		Time pressure		43.7%	41.3%		2011		19
		Adequate work life balance		46.8%	53.1%	56	2011		19
		Long commute greater than 2 hours a day		16.1%	11.6%	15	2011		19
		Shares a meal with family (≥ 5 days per week)		70.8%	66.3%	37	2011		19
		Proportion of workers commuting out of Shire for work	5,971	47.8%			2011		15
4. Health conditions/disease		Life expectancy males	81.2		80.3	9	2011		9
		Life expectancy females	86.3		84.4	2	2011		9
		Emergency Department presentations per 1,000 population	144.8		249.9		2010		3
		Low birth weight babies		4.4%	6.6%	76	2008		9
		% persons reporting asthma		9.1%	10.7%	63	2008		9
		% of persons reporting diabetes type 2		2.4%	4.8%	77	2008		9

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	% persons who are overweight or obese		41.1%	49.8%		2011-2012		10
	Cancer incidence - females per 100,000 population	5.4		4.5		2011		9
	Cancer incidence - males per 100,000 population	5.6		5.7		2011		9
	Vaccine preventable admissions per 1,000	0.7		0.8	41	2011-2012		9
	Notifications of chlamydia per 1,000 population	3.5		3.5	24	2011		9
	Notifications per 1,000 population of Influenza	0.3		0.6	61	2011		9
5. Environmental health	Percentage of registered food premises inspected annually	350	96.0%			2012		17
	Number of food related complaints as proportion of no. food premises		6.0%			2012		17
	Number of noise complaints	33				2012		17
	Noise complaints as % of all environmental health complaints		25.0%			2012		17
	% of resolved noise complaints annually		97.0%			2012		17
6. Alcohol/drug management	Drug and alcohol clients per 1,000 population	3.3		5.1	68			9
	Purchased alcohol in the last 7 days		47.9%	36.3%	6	2011		19
	7 day \$ spend on packaged liquor (of those purchasing)	\$37		\$45		2011		19
	Adults (%) at high risk of short term harm from alcohol consumption		55.6%	45.3%		2011-2012		10
	Adults (%) at high risk of long term harm from alcohol consumption		2.9%	3.3%		2011-2012		10
	Proportion abstaining from alcohol consumption		9.6%	18.6%		2011-2012		10
	Alcohol related ambulance attendances	46			Regional LGA rank 16	2011-2012		1
	Alcohol related ambulance attendances by month	Dec=12 all other months 6 or less				2011-2012		1
	Wholly alcohol attributable hospital admissions per 10,000	43 (no.=109)		60		2009-2010		18
	Wholly alcohol attributable hospital admissions 15-24 yr olds per 10,000	56 (no.=18)		49		2009-2010		18
	Alcohol related assaults (reported as a range) per 10,000	11-11.78 (no. 28-30)		12.50-12.90		2009-2010		18
	Alcohol related courses of treatment delivered per 10,000	57 (no. 147)		43		2009-2010		18

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	Alcohol related serious road injuries per 10,000	6.28 (no. = 16)		4.09		2009-2010		18
	Liquor license outlet density per 10,000 residents 15 years and over	58 (no. = 119)		27		2009		18
	Drug related ambulance attendances (17 categories including cannabis, amphetamine, benzodiazepine, heroin, anti-depressant)	47 (less than 5 per type)			Regional LGA rank 23	2011-2012		1
	Drug offences per 100,000	75 (no. = 20)		336		2011-2012		20
	Smoking Status		14.1%	15.7%		2011-2012		10
	Support for smoking ban in outside dining areas		74.3%	69.8%		2011		19
7. Community safety/crime	Rape crime per 100,000	11.3 (no. = 3)		36.7		2011-2012		20
	Sex crime (non rape) per 100,000	72 (no. = 19)		112		2011-2012		20
	Assault per 100,000	343.5 (no. = 91)		755		2011-2012	36% increase from 2010-11	20
	Residential burglary per 100,000	456 (no. = 121)		524		2011-2012	87% increase from 2010-11	20
	Theft from motor vehicle per 100,000 population	826		837		2011-2012	96% increase from 2010-11	20
	Behaviour in public crimes per 100,000 population	264		114		2011-2012	42% increase from 2010-11, Vic 8.3% decrease	20
	All crime against the person per 100,000 population	435		923		2011-2012		20
	All crime against property per 100,000 population	3,586		4935		2011-2012		20
	All crime offences per 100,000 population	4,681		7082		2011-2012		20
	Change in crime against the person per 100,000 population	26% annual increase		10% annual increase		2010-11 to 2011-12		20
	Change in crime against property per 100,000 population	23% annual increase		3% annual increase		2010-11 to 2011-12		20
	Change in all crime offences per 100,000 population	22.5% increase		6.8% increase		2010-11 to 2011-12		20
	Perceptions of safety - walking alone during day		99.8%	97.0%		2011		19

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	Perceptions of safety - walking alone during night		88.7%	70.3%		2011		19
	Safe on street after dark		79.7%	59.0%		2008		12
	Police callouts for family violence incidents per 100,000	430		908		2011-2012		3
	% change in decade in police callouts for family violence incidents		64% increase	119% increase		2011-2012		3
	Family violence incidents per 1,000 population	4.7		9.1	72	2011-2012		9
	Proportion prepared to intervene in a situation of domestic violence		95.5%	93.1%		2011		19
8. Children and families	Number and proportion of 0-9 years Census 2011	3,757	14.5%	12.5%		2011		15
	Number and proportion of 0-9 years estimated 2013	3,984	14.1%			2013		14
	Forecast number 0-9 years by 2017	4,508	13.9%			2017		14
	Australian early development index (AEDI) proportion of children vulnerable on 2 or more domains		5.9%	9.5%		2012		7
	Winchelsea/Deans Marsh and surrounds: AEDI Proportion of children vulnerable on 2 or more domains		14.3%	9.5%		2012		7
	Torquay: AEDI proportion of children vulnerable on 2 or more domains		2.6%	9.5%		2012		7
	AEDI proportion of children- change between 2009 and 2012	Increase vulnerability for 4 of the 5 measures				2012		7
	Children fully immunised at 24-27 mths		90.8%	93.4%	68			9
	Need for assistance with core tasks due to disability % of 0-8yrs		1.4%	3.7%		2011		15
	Percentage of infants fully breastfed at 3 mths		67.3%	51.8%	3			9
	Rate of hospital separations for dental caries/cavities 0-8yrs per 1,000	7.6		6.3				3
	Rate of hospital separations for chronic tonsillitis 0-8 per 1,000	5.6		4.2				3
	Rate of child protection substantiations per 1,000 children aged 0 to 8 years	1.7		7.4		2007-2008		6
9. Youth	Number and proportion 12 - 24 years Census 2011	3,785	14.6%	17.1%		2011		15
	Number and proportion 12 - 24 years estimated 2013	4,073	14.4%			2013		14
	Forecast 12-24 years 2017	4,607	14.2%			2017		14
	Wholly alcohol attributable hospital admissions 15-24 yr olds per 10,000	56 (no.=18)		49		2009-10		18
	People 15-19 not employed or enrolled in education	62	4.3%	5.8%		2011		3
	People 20-24 not employed or enrolled in education	92	8.3%	11.5%		2011		3
	20-24 year olds who completed year 10 or less		10.7%	12.0%		2011		3

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	20-24 yr olds studying at TAFE		10.8% (129)	8.5		2011		3
	20-24 yr olds studying at University		24.5% (292)	29.2		2011		3
	% of year 9 students who attain national minimum standards in reading		89.5%	92.3%	57	2010		9
	% of year 9 students who attain national minimum standards in writing		84.2%	89.4%	62	2010		9
	% of year 9 students who attain national minimum standards in numeracy		88.9%	94.4%	77	2010		9
	Number of 10-24 year olds with a disability	79				2011		3
10. Older people	Number and proportion 65 years and over Census 2011	3,722	14.4%	13.1%		2011		15
	Number and proportion 65 years and over estimated 2013	4,091	14.4%			2013		14
	Forecast 60 years 2017	4,861	15.0%			2017		14
	Percentage of people 75 and over who live alone		33.5%	35.9%	67	2011		9
	*Proportion female		72.5%	73.9%				
	* Proportion male		27.5%	26.1%				
	Home and Community Care (HACC) clients aged 60-69 per 1,000 target population	458		197	7	2011-2012		9
	HACC clients aged 70 and over per 1,000 target population	747		340	2	2011-2012		9
	Aged care places (high care) per 1,000 eligible population	40.5		42.2	40	2012		9
	Aged care places (low care) per 1,000 eligible population	42.9		45.7	55	2012		9
	Age pension recipients per 1,000 eligible population	644		704	67			9
	Number of aged pension recipients	2,479					2036 in 2008	13
11. Accessible health services / other services	General practitioners per 1,000 population	1.29		1.18	21	2013		9
	General practice clinics per 1,000 population	0.42		0.54	64	2012		9
	Allied health services sites per 1,000 population	0.53		0.56	53	2012		9
	Number of hospitals/health services	2		294				9
	Main public hospital attended	Geelong				2011-2012		9
	Primary health occasions of service per 1,000 pop	2,52.4		163.7		2010		3
	Ambulatory care sensitive conditions (ACSCs) admission rate per 1,000 population	24.5		31.9	71	2011-2012		9
	Emergency Department presentations per 1,000 population	152.3		259.6	64	2011-2012		9
	ACSC average length of stay (days)	3.74		5.21	79	2011-2012		9

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	ACSC acute per 1,000 population	13.7		14.5	55	2011-2012		9
	ACSC chronic per 1,000 population	10.3		17.0	76	2011-2012		9
	ACSC vaccine preventable per 1,000 population	0.7		0.8	41	2011-2012		9
	Dental services per 1,000 population	0.04		0.21	72	2011-2012		9
	ACSC dental conditions - standardised admission rate ratio	1.7		1	5	2011-2012		8
	Percentage of population with private health insurance		54.0%	48.0%	13	2007-2008		9
	Good facilities and services like shops, childcare, schools libraries		73.5%	85.0%	60	2008		12
Cultural environment								
12. Changing communities- permanent population	Estimated resident population	27,167				June 2012		2
	Average annual growth rate 2006 to 2011		3% per year			2006-2011		2
	Total forecast population 2031	44,787				2031		14
	Forecast population by 2017	32,427				2017		14
	Birth notifications	339				2011-2012		16
	Number of first time mothers	136				2011-2012		16
	Median age	40		37		2011		15
13. Changing communities- part time/peak populations	Peak overnight Population Dec2012/Jan 2013	83,654				2012-2013		4
	Voting population (18 yrs and over plus includes non resident ratepayers)	29,525				2011		22
	Proportion of non resident rate payers		59.0%					17
	Unoccupied dwellings	7,000	42.0%			2011		15
	Visitors to Great Ocean Road region	7,600,000				2012		23
	Tourist destinations	Top 5 visited locations Victorian Coast include Lorne and Torquay				2012		21
14. Arts and Culture	Attended arts activities or events (in the last 3 months)		74.1%	63.6%		2011		19
	Made or created arts or crafts (in last 3 months)		48.0%	34.9%		2011		19
15. Community connectedness/ involvement	Number of people not living in Surf Coast Shire 5 years ago (new residents in last 5 years).	6,719				2011		15
	Number of people living alone.	1,928	20.0%	23.5%		2011		15
	Number of dog registrations.	5,345				2013		17
	Number of cat registrations	906				2013		17

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	Community satisfaction: community and cultural activities, importance vs performance	Importance 61 (rated lowest importance of 15 Council Services) Performance 66				2013		11
	Participation in organised sport		55.0%	41.0%		2008		12
	Members of organised groups such as sports, church, community groups or professional associations		70.4%	61.0%		2008		12
	The area has a wide range of community and support groups		67.5%	64.1%		2008		12
	Participation in citizen engagement (in the last year)		69.3%	50.5%		2011		19
	Volunteering (≥ once per month)		43.7%	34.3%		2011		19
	Parental participation in schools.		69.7%	49.0%		2008		12
	On decision making board or committee		19.2%	19.0%		2008		12
	Can get help from friends family and neighbours when needed		93.4%	91.0%		2008		12
	Internet access at home		79.0%	74.0%		2011		15
	Social networking used to organise time with friends/family		23.4%	35.1%		2011		19
16. Spirituality	Proportion Christian	14,361	55.0%	57.5%		2011		15
	Proportion non Christian	493	1.9%	9.3%		2011		15
	Proportion no religion	8,364	32.0%	24.0%		2011	27% in 2006 (Vic 20.4%)	15
17. Aboriginal people and Torres Strait Islander people	Aboriginal people and Torres Strait Islander people	147	0.6%	0.7%		2011	Increased from 78 in 2006	15
18. Ethnicity	Residents born overseas		11.4%	26.2%		2011		
	Speak a language other than english at home		3.4%	23.1%		2011		15
	Poor english proficiency (speaks english: not well or not at all)		0.3%	4.0%		2011		15
	Most common language spoken, other than english		German and Italian 0.4% each			2011		15
	Community acceptance of diverse cultures		52.0%	50.6%		2011		19
19. Disability	Disability rate		3.5%	5.0%				
	Number and % of 10-24 year olds with a disability	79	5.4%	6.1%		2011		3
	% of 65-69 year olds with a disability	59	5.1%	8.0%		2011		3
	% of 80-84 year olds with a disability	97	22.0%	29.0%		2011		3

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	%of 90-95 yr olds with a disability	69	64.0%	64.0%		2011		3
	Number of people on a disability support pension	604				2012	497 in 2008	13
	Number of people with a disability	867				2011		3
	Disability support pension recipients per 1,000 eligible population.	36		55.7	71	2012		9
	Number of people on a carer's payment	137				2012		13
	People with severe and profound disability living in the community.		2.5%	3.8%	74	2011		9
	People with need for assistance with core activities		3.4%	4.8%	75	2010		15
	Female disability adjusted life years per 1,000 pop	120		129		2011		3
	Male disability adjusted life years per 1,000 pop	136		143		2010		3
	People (aged 15 plus) providing care to a person with a disability, a long term illness or problems related to old age	2,476	12.2%	11.3%		2011		15
Built environment								
20. Dwellings	New dwellings per 1,000 population	12.9		8.9	11	2011-2012		9
	Forecast new dwellings 2013-2017	2,315				2013-2017		14
	Proportion of dwellings medium/high density dwellings (Flats and Units)	2,095	12.6%	23.4%		2011		15
	Caravans/cabins/houseboats	78	0.5%	0.5%				15
21. Recreation facilities	Community satisfaction: best thing about council - top response recreational/Sporting facilities		11.0%			2013		11
	Community satisfaction: recreational facilities, importance vs performance	Importance 74 Performance 70				2013		11
22. Other community facilities	Community satisfaction: areas for improvement 6th highest response - Infrastructure		6.0%			2013		11
23. Safe built environment	Perceptions of safety - walking alone during day		99.8%	97.0%		2011		19
	Perceptions of safety - walking alone during night		88.7%	70.3%		2011		19
24. Urban Design	It's a pleasant environment , nice streets, well planned, open spaces		90.6%	81.0%		2008		12
25. Roads/pathways	Community satisfaction: condition of local streets and footpaths, importance vs performance	importance 73 performance 59				2013		11
	Workers who walked or rode a bicycle to work	438	3.6%	4.5%		2011		15
26. Transport	Percentage of population near to public transport		32.2%	74.3%	52			
	Used public transport to get to work	380	3.1%	11.0%		2011		15
	Proportion of households with no motor vehicle	296	3.1%	8.3%	77	2011		15

Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
	People who experienced transport limitations in the last 12 months (% adult population)		18.4%	20.4%		2007		3
Natural environment								
27. Open Space/Natural Environment	Visit to green space (≥ once per week)		74.7%	50.7%	3	2011		19
	Community satisfaction: best thing about council - 4th highest response beach/foreshore/waterfront		8.0%			2013		11
28. Climate change/bushfires	Community satisfaction: emergency and disaster management: importance vs performance	Importance 82 Satisfaction 70 (most important of 15 services surveyed)				2013		11
29. Sustainable living	Percentage of household waste recycled		56.0%	44.0%		2009-2010		5
	Proportion of people in households that collect waste water		45.3%	41.3%		2011		5
	Number of community gardens	4				2013		17
Economic environment								
30. Local employment opportunities	Number of jobs	7,156				2011		15
	Number of employed persons	12,488				2011		15
	Proportion of jobs in shire taken by shire residents		70%			2011		15
	Proportion of shire employed residents who work in the shire		40%			2011		15
	Number of residents living and working locally	5,031						
	Number of residents working outside the shire	5,971						
	Number of residents work location unknown	1,486						
31. Economic circumstances	People who could raise \$2000 in an emergency		90.5%	85.0%		2008		12
	% of persons with individual income < \$400 per week		36.3%	39.9%	71	2011		9
	% female income < \$400 per week		44.7%	47.1%		2011		9
	% male income < \$400 per week		27.4%	32.1%		2011		9
	Median household Income	\$1,277		\$1216	24	2011		9
	Proportion of households in lowest income quartile 2011		21.9%			2011	25.2% in 2006	15
	Proportion of households in highest income quartile 2011		26.3%			2011	22.5% in 2006	15
	Unemployment rate	501	3.9%	5.4%		2011		15
	Managers or professionals		40.6%	35.5%		2011		15
32. Educational outcomes	Percentage of persons who did not complete yr 12		43.5%	43.7%	59	2011		9
	Percentage of people who completed a higher education qualification		43.3%	45.7%	20	2011		9
	Percentage of students attending government school		63.3%	61.6%	44	2011		9

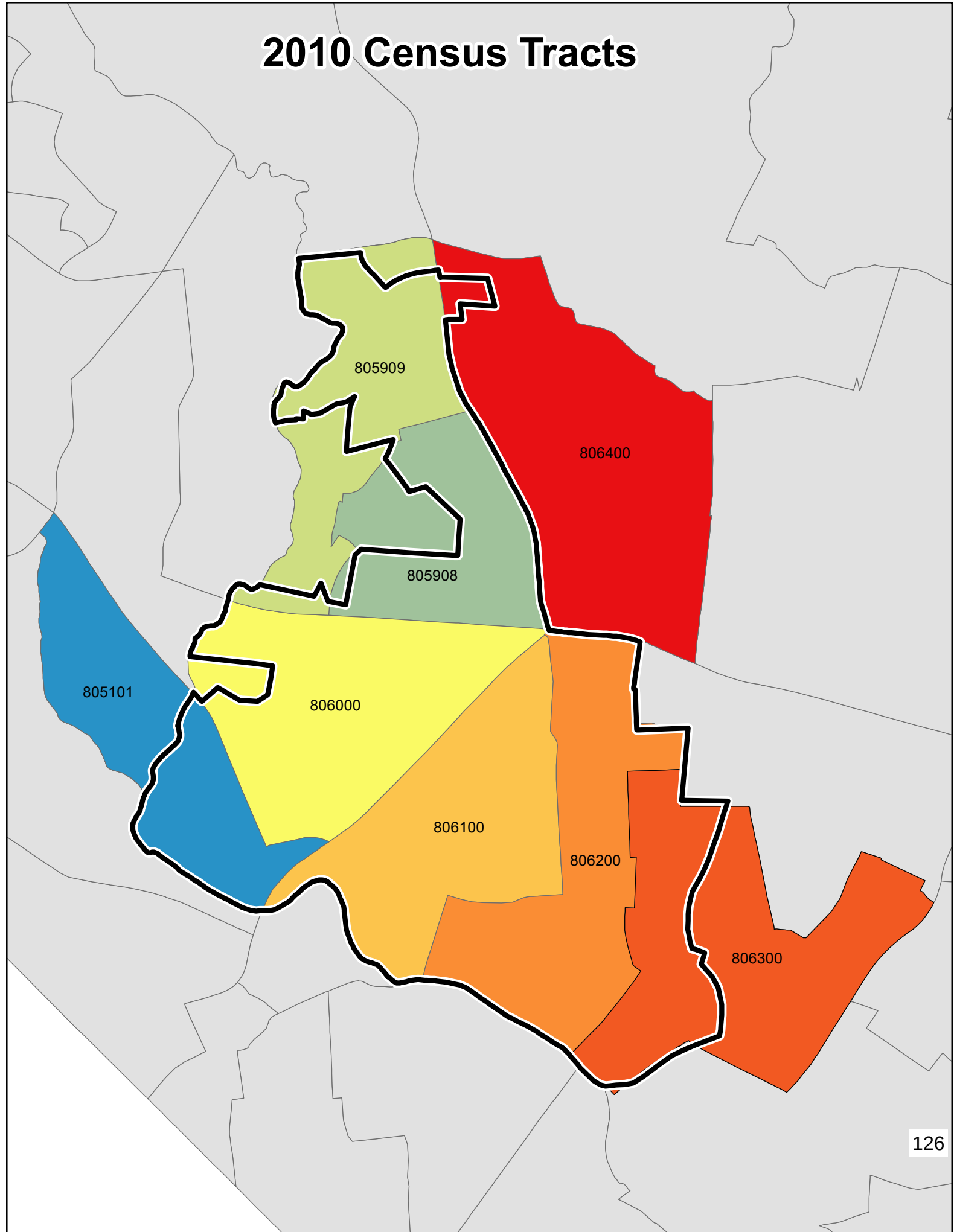
Issue	Indicator	SURF COAST SHIRE Measure		Victoria	LGA ranking	Year	Change over time	Source
		Number	%					
33. Housing stress	Mortgage stress (Low income households (bottom 40%) spending more than 30% income on mortgage)		9.9%	11.4%	57	2011		9
	Rental stress (Low income households (bottom 40%) spending more than 30% income on rent)		23.7%	25.1%	49	2011		9
	Percentage of rental housing that is affordable		10.6%	20.7%	57	2012		9
	Median house price	\$577,500		\$420,000		2011		13
	Social housing as a percentage of total dwellings	80	0.6%	3.8%		2012		13
34. Disadvantage	SEIFA (Index of disadvantage) Surf Coast Shire	1,067			7th most advantaged	2011		15
	SEIFA (Index of disadvantage) Torquay Jan Juc	1,083				2011		15
	SEIFA (Index of disadvantage) Winchelsea	936		Score just above the 5 most disadvantaged LGAs		2011		15

Data sources

- Ambulance Victoria, Turning Point Alcohol and Drug Centre and Victorian Department of Health, "Alcohol and Drug related Ambulance Attendances – 2011/12"
- Australian Bureau of Statistics Cat. No. 3218.0 Regional Population Growth, 2013
- City of Greater Dandenong and VLGA, Profiles for Victorian Communities, <http://www.socialstatistics.com.au/>
- City of Greater Geelong, Annual Economic Indicators Bulletin, 2012
- Community Indicators Victoria, 2013, <http://www.communityindicators.net.au/>
- Department of Education and Early Childhood Development, Early Childhood Community Profile, 2010
- Department of Education, Employment and Workplace relations, Australian Early Development Index Community Profile, 2012
- Department of Health - Health Status of Victorians <http://www.health.vic.gov.au/healthstatus/>
- Department of Health, local government area profiles, 2012 <http://www.health.vic.gov.au/modelling/planning/lga.htm>
- Department of Health, Victorian Population Health Survey 2011/12
- Department of Planning and Community Development, Community Satisfaction Survey Surf Coast Shire Council, 2013
- Department of Planning and Community Development, Indicators of Community Strength at the Local Government Area level in Victoria, 2008
- Housing in Victoria Website, <http://www.housinginvictoria.com.au/>
- .id Consulting Forecast, http://www.surfcoast.vic.gov.au/My_Council/Population_Information
- .id Consulting Profile, Australian Bureau of Statistics Census 2011, http://www.surfcoast.vic.gov.au/My_Council/Population_Information
- Maternal and Child Health Services Annual Report 2011/12
- Surf Coast Shire internal database
- Turning Point Alcohol and Drug Centre "Alcohol related harms and use across Victorian Local Government Areas 1999-2000 to 2009-10".
- VicHealth Indicators Survey 2011, <http://www.vichealth.vic.gov.au/Research/VicHealth-Indicators/LGA-Profiles.aspx>
- Victoria Police Crime Statistics, 2011/12
- Victorian Coastal Council, Victorian Coastal and Marine Environment, Community Attitudes and Behaviour: Wave 4, Final Report, 2012
- Victorian Electoral Commission
- Tourism Victoria, Great Ocean Road Market Profile, 2012

Data Note: Victoria Population Health Survey (no.10), VicHealth Indicators Survey (no.19) and DPCD Indicators of Community Strength (no. 12) not total shire population, around 400 to 450 people surveyed. DPCD, Community Satisfaction Survey, Surf Coast Shire 2013 (no.11), around 600 people.

2010 Census Tracts





Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Joseph Solomon, W5

Submitting Department: Legislative

Item Type: Budget

Agenda Section: Discussion Items (8:50 p.m. - 9:40 p.m.)

SUBJECT

HWRAC FY18 Budget Priority: Health Impacts of Climate Change Seminars (5 minutes)

Motion

Discussion, Action TBD

Recommendation:

I move that the Mayor and Council include Health Impacts of Climate Change Seminars as a City budget priority to be funded in the FY18 Hyattsville municipal budget.

Sponsor(s):

Solomon, Ward, Perry

ATTACHMENTS

[HWRAC Discussion_Climate Change_cover.pdf](#)

[a_human_health_perspective_on_climate_change_full_report_508.pdf](#)

Summary Background:

A changing climate impacts our health and wellbeing. The major public health organizations of the world (including the National Institutes of Health) have said that climate change is a critical public health problem. Climate change makes many existing diseases and conditions worse, but it may also help introduce new pests and pathogens into new regions or communities. As the planet warms, oceans expand and the sea level rises, floods and droughts become more frequent and intense, and heat waves and hurricanes become more severe. The most vulnerable people—children, the elderly, the poor, and those with underlying health conditions—are at increased risk for health effects from climate change. Climate change also stresses our health care infrastructure and delivery systems.

These seminars will provide public education on these health impacts.

Additional Information:

<https://www.niehs.nih.gov/research/programs/geh/climatechange/index.cfm>

Next Steps:

Pending approval from the City Council, the HWRAC will collaborate with Health partners to organize a series of informational sessions on the Health Impacts of Climate Change.

Fiscal Impact:

2,000.00

City Administrator Comments:

The City's Environment Advisory Committee is seeking \$1,000 for a speaker series on topics including climate change. Staff has connected the chairs of both committees to determine if a partnership is possible to reduce cost and avoid duplication.

Community Engagement:

Discussed and approved during HWRAC meeting.

Strategic Goals:

Goal 3: Public Safety & Quality of Life

Legal Review Required?

N/A



A Human Health Perspective **On Climate Change**

A Report Outlining the
Research Needs on the
Human Health Effects of
Climate Change

APRIL 22, 2010

A Human Health Perspective On Climate Change



A Report Outlining the Research Needs on the Human Health Effects of Climate Change

The Interagency Working Group on Climate Change and Health¹

APRIL 2010

Published by *Environmental Health Perspectives* and
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CORRESPONDENCE: Send all correspondence to Dr. Christopher J. Portier, Senior Advisor to the Director, Principle Investigator, Environmental Systems Biology, PO Box 12233, MD B2-08, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709 USA, E-mail: portier@niehs.nih.gov, Telephone: 919-541-3484, Fax: 919-541-1994.

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¹ **DISCLAIMER:** The Interagency Working Group on Climate Change and Health (IWGCCCH) is an ad hoc group formed by participating federal agencies and organizations at the invitation of the National Institute of Environmental Health Sciences (NIEHS), National Oceanic and Atmospheric Administration (NOAA), Centers for Disease Control and Prevention (CDC), and Environmental Protection Agency (EPA) following the January 2009 "Workshop on a Research Agenda for Managing the Health Risks of Climate Change," sponsored by the Institute of Medicine Roundtable on Environmental Health Sciences, Research, and Medicine. This report identifies gaps in knowledge of the consequences for human health of climate change, and suggests research to address them. The content, views, and perspectives presented in this report are solely those of the authors, and do not reflect the official views, policies, or implied endorsement of any of the individual participating federal agencies or organizations.

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The Interagency Working Group on Climate Change and Health

Christopher J. Portier, PhD (COORDINATING LEAD AUTHOR)
National Institute of Environmental Health Sciences

Kimberly Thigpen Tart, JD (COORDINATING EDITOR)
National Institute of Environmental Health Sciences

Sarah R. Carter, PhD
AAAS Fellow, U.S. Environmental Protection Agency

Caroline H. Dilworth, PhD
National Institute of Environmental Health Sciences

Anne E. Grambsch
U.S. Environmental Protection Agency

Julia Gohlke, PhD
National Institute of Environmental Health Sciences

Jeremy Hess, MD, MPH (LEAD AUTHOR)
Centers for Disease Control and Prevention

Sandra N. Howard
Department of Health and Human Services

George Luber, PhD (LEAD AUTHOR)
Centers for Disease Control and Prevention

Jeffrey T. Lutz, PhD
National Oceanic and Atmospheric Administration

Tanya Maslak, MPH (LEAD AUTHOR)
*U.S. Global Change Research Program,
University Corporation for Atmospheric Research*

Natasha Prudent, MPH
Centers for Disease Control and Prevention

Meghan Radtke, PhD (LEAD AUTHOR)
AAAS Fellow, U.S. Environmental Protection Agency

Joshua P. Rosenthal, PhD
Fogarty International Center

Teri Rowles, DVM, PhD
National Oceanic and Atmospheric Administration

Paul A. Sandifer, PhD
National Oceanic and Atmospheric Administration

Joel Scheraga, PhD
U.S. Environmental Protection Agency

Paul J. Schramm, MS, MPH
Centers for Disease Control and Prevention

Daniel Strickman, PhD (LEAD AUTHOR)
U.S. Department of Agriculture, Agricultural Research Service

Juli M. Trtanj, MES (LEAD AUTHOR)
National Oceanic and Atmospheric Administration

Pai-Yei Whung, PhD
U.S. Environmental Protection Agency

Participating Agencies

In addition to the working group, many scientists and staff from the following agencies contributed to the development and review of this white paper. Staff of the U.S. Global Change Research Program provided logistical and technical support, but did not conduct a formal review.

Centers for Disease Control and Prevention

- National Center for Environmental Health

National Institutes of Health

- National Institute of Environmental Health Sciences
- Fogarty International Center
- Trans-NIH Working Group on Climate Change and Health

National Oceanic and Atmospheric Administration

Office of the Secretary, Department of Health and Human Services

U.S. Environmental Protection Agency

U.S. Department of Agriculture

U.S. Department of State

Executive Summary

The purpose of this paper is to identify research needs for all aspects of the research-to-decision making pathway that will help us understand and mitigate the health effects of climate change, as well as ensure that we choose the healthiest and most efficient approaches to climate change adaptation.

Climate change endangers human health, affecting all sectors of society, both domestically and globally. The environmental consequences of climate change, both those already observed and those that are anticipated, such as sea-level rise, changes in precipitation resulting in flooding and drought, heat waves, more intense hurricanes and storms, and degraded air quality, will affect human health both directly and indirectly. Addressing the effects of climate change on human health is especially challenging because both the surrounding environment and the decisions that people make influence health. For example, increases in the frequency and severity of regional heat waves—likely outcomes of climate change—have the potential to harm a lot of people. Certain adverse health effects can probably be avoided if decisions made prior to the heat waves result in such things as identification of vulnerable populations such as children and the elderly and ensured access to preventive measures such as air conditioning. This is a simplified illustration; in real-life situations a host of other factors also come into play in determining vulnerability including biological susceptibility, socioeconomic status, cultural competence, and the built environment. In a world of myriad “what if” scenarios surrounding climate change, it becomes very complicated to create wise health policies for the future because of the uncertainty of predicting environmental change and human decisions. The need for sound science on which to base such policies becomes more critical than ever.

Recognizing the complexity of this issue, an ad hoc Interagency Working Group on Climate Change and Health (IWGCCH)² assembled to develop a white paper on relevant federal research and science needs, including research on mitigation and adaptation strategies. Examples of mitigation and adaptation research needs are identified, but a comprehensive discussion of these issues is not included. These research and science needs broadly include basic and applied science, technological innovations and capacities, public health infrastructure, and communication and education. Consideration is also given to the potential structure of a federal climate change and health research agenda and the use of scientific research results for applications and decision making. The purpose of this paper is to identify research critical for understanding the impact of climate change on human health so that we can both mitigate and adapt to the environmental effects of climate change in the healthiest and most efficient ways. Although the group recognizes the global nature of climate change's impacts on human health, the primary focus of this paper is on the situation in the United States.

This report is organized around 11 broad human health categories likely to be affected by climate change.³ Categories are arranged in alphabetical order, and no prioritization—for instance as to likelihood of occurrence, severity of effects, or depth of current knowledge—is implied. Each category is broken into sections that introduce the topic, explain its

relationship to climate change, and identify the basic and applied research needs of that category, as well as crosscutting issues where relevant. Most investigations of climate change and health have relied on environmental and ecological effects to extrapolate potential human health impacts; the IWGCCH deliberately chose to emphasize the need for research on human health outcomes over environmental impacts for this reason: this approach highlights direct links between climate change and federal research priorities that are often disease- or outcome-specific, and a focus on human health outcomes enables a holistic approach to exploring climate change-related health impacts. We recognize that the health consequences identified in this document are not exhaustive, and that because so many climate change effects are prospective, some of the research needs enumerated may be speculative. As more information becomes available, new research needs may be identified and others rejected, but it is our intent that this report may serve as a baseline discussion from which agencies can proceed.

² CDC, HHS/OS, EPA, NASA, NIEHS, NIH/Fogarty, NOAA, DOS, USDA, USGCRP

³ asthma, allergies, and airway diseases; cancer; cardiovascular disease and stroke; alterations in normal development; heat-related morbidity and mortality; mental health and stress disorders; neurological diseases and disorders; nutrition and food-borne illness; vector-borne and zoonotic disease; waterborne disease; weather-related morbidity and mortality

Highlights:

Asthma, Respiratory Allergies, and Airway Diseases—

Respiratory allergies and diseases may become more prevalent because of increased human exposure to pollen (due to altered growing seasons), molds (from extreme or more frequent precipitation), air pollution and aerosolized marine toxins (due to increased temperature, coastal runoff, and humidity) and dust (from droughts). Mitigation and adaptation may significantly reduce these risks. Research should address the relationship between climate change and the composition of air pollutant mixtures (e.g., how altered pollen counts and other effects of climate change affect the severity of asthma) to produce models to identify populations at risk. Such tools support the use of science in understanding disease risks and as such, are an integral component of developing effective risk communication and targeting the messages to vulnerable populations.

Cancer—Many potential direct effects of climate change on cancer risk, such as increased duration and intensity of ultraviolet (UV) radiation, are well understood; however the potential impact of changes in climate on exposure pathways for chemicals and toxins requires further study. Science should investigate the effects of mitigation and adaptation measures on cancer incidence so that the best strategies can be developed and implemented; for example, research to inform understanding of the benefits of alternative fuels, new battery and voltaic cells, and other technologies, as well as any potential adverse risks from exposure to their components and wastes. Better understanding of climate change impacts on the capacity of ocean and coastal systems to provide cancer curative agents and other health-enhancing products is also needed.

Cardiovascular Disease and Stroke—Climate change may exacerbate existing cardiovascular disease by increasing heat stress, increasing the body burden of airborne particulates, and changing the distribution of zoonotic vectors that cause infectious diseases linked with cardiovascular disease. Science that addresses the cardiovascular effects of higher temperatures, heat waves, extreme weather, and changes in air quality on health is needed, and this new information should be applied to development of health risk assessment models, early warning systems, health communication strategies targeting vulnerable populations, land use decisions, and strategies to meet air quality goals related to climate change. In some areas, cardiovascular and stroke risks resulting from climate change could be offset by reductions in air pollution due to climate change mitigation.

Foodborne Diseases and Nutrition—Climate change may be associated with staple food shortages, malnutrition, and food contamination (of seafood from chemical contaminants, biotoxins, and pathogenic microbes, and of crops by pesticides). Science research needs in this area include better understanding of how changes in agriculture and fisheries

may affect food availability and nutrition, better monitoring for disease-causing agents, and identification and mapping of complex food webs and sentinel species that may be vulnerable to climate change. This research could be used to prepare the public health and health care sectors for new illnesses, changing surveillance needs, and increased incidence of disease, as well as development of more effective outreach to affected communities.

Heat-Related Morbidity and Mortality—Heat-related illness and deaths are likely to increase in response to climate change but aggressive public health interventions such as heat wave response plans and health alert warning systems can minimize morbidity and mortality. Additional science should be focused on developing and expanding these tools in different geographic regions, specifically by defining environmental risk factors, identifying vulnerable populations, and developing effective risk communication and prevention strategies.

Human Developmental Effects—Two potential consequences of climate change would affect normal human development: malnutrition—particularly during the prenatal period and early childhood as a result of decreased food supplies, and exposure to toxic contaminants and biotoxins—resulting from extreme weather events, increased pesticide use for food production, and increases in harmful algal blooms in recreational areas. Research should examine the relationship between human development and adaptations to climate change, such as agriculture and fisheries changes that may affect food availability, increased pesticide use to control for expanding disease vector ranges, and prevention of leaching from toxic waste sites into floodwaters during extreme weather events, so that developmental consequences can be prevented.

Mental Health and Stress-Related Disorders—By causing or contributing to extreme weather events, climate change may result in geographic displacement of populations, damage to property, loss of loved ones, and chronic stress, all of which can negatively affect mental health. Research needs include identifying key mental health effects and vulnerable populations, and developing migration monitoring networks to help ensure the availability of appropriate health care support.

Neurological Diseases and Disorders—Climate change, as well as attempts to mitigate and adapt to it, may increase the number of neurological diseases and disorders in humans. Research in this area should focus on identifying vulnerable populations and understanding the mechanisms and effects of human exposure to

neurological hazards such as biotoxins (from harmful algal blooms), metals (found in new battery technologies and compact fluorescent lights), and pesticides (used in response to changes in agriculture), as well as the potentially exacerbating effects of malnutrition and stress.

Vectorborne and Zoonotic Diseases—Disease risk may increase as a result of climate change due to related expansions in vector ranges, shortening of pathogen incubation periods, and disruption and relocation of large human populations. Research should enhance the existing pathogen/vector control infrastructure including vector and host identification; integrate human with terrestrial and aquatic animal health surveillance systems; incorporate ecological studies to provide better predictive models; and improve risk communication and prevention strategies.

Waterborne Diseases—Increases in water temperature, precipitation frequency and severity, evaporation-transpiration rates, and changes in coastal ecosystem health could increase the incidence of water contamination with harmful pathogens and chemicals, resulting in increased human exposure. Research should focus on understanding where changes in water flow will occur, how water will interact with sewage in surface and underground water supplies as well as drinking water distribution systems, what food sources may become contaminated, and how to better predict and prevent human exposure to waterborne and ocean-related pathogens and biotoxins.

Weather-Related Morbidity and Mortality—Increases in the incidence and intensity of extreme weather events such as hurricanes, floods, droughts, and wildfires may adversely affect people's health immediately during the event or later following the event. Research aimed at improving the capabilities of healthcare and emergency services to address disaster planning and management is needed to ensure that risks are understood and that optimal strategies are identified, communicated, and implemented.

In addition to the research needs identified in the individual research categories, there are crosscutting issues relevant to preventing or avoiding many of the potential health impacts of climate change including identifying susceptible, vulnerable, and displaced populations; enhancing public health and health care infrastructure; developing capacities and skills in modeling and prediction; and improving risk communication and public health education. Such research will lead to more effective early warning systems and greater public awareness of an individual's or community's health risk from climate change, which should translate into more successful mitigation and adaptation

strategies. For example, health communications research is needed to properly implement health alert warning systems for extreme heat events and air pollution that especially affects people with existing conditions such as cardiovascular disease. Such a risk communication pilot project might demonstrate communication practices that are effective in multiple areas, and contribute to a comprehensive strategy for addressing multiple health risks simultaneously.

Other tools are needed and should be applied across multiple categories to close the knowledge gaps, including predictive models to improve forecasting and prevention, evaluations of the vulnerability of health care and public health systems and infrastructure, and health impact assessments. Trans-disciplinary development would help to ensure tools such as improved baseline monitoring that will be more widely applicable, and thus more efficient and cost effective than those currently available. In fact, many of the identified science needs will require trans-disciplinary responses. For example, to study how heat waves alter ambient air pollution and the resulting combined impact of heat and pollution on human illness and death, will require expertise in atmospheric chemistry, climate patterns, environmental health, epidemiology, medicine, and other science fields. Given the complexity of the science needs and the potential overlap of research questions across disciplines, promoting trans-disciplinary collaboration among and within federal agencies would be a logical approach and should be a high priority.

Recently, the National Research Council issued a report addressing how federal research and science could be improved to provide support for decision and policy making on climate change and human health.⁴ Specifically, the report calls for a more complete catalogue of climate change health impacts, increasing the power of prediction tools, enhancing integration of climate observation networks with health impact surveillance tools, and improving interactions among stakeholders and decision makers. The IWGCCH approached this research needs assessment with these goals in mind. The next step will be for federal agencies to discuss the findings of this white paper with stakeholders, decision makers, and the public as they work to incorporate and prioritize appropriate research needs into their respective science agendas and collaborative research efforts. A coordinated federal approach will bring the unique skills, capacities, and missions of the various agencies together to maximize the potential for discovery of new information and opportunities for success in providing key information to support responsive and effective decisions on climate change and health.

⁴ National Research Council (U.S.). Committee on Strategic Advice on the U.S. Climate Change Science Program., et 2009, Washington, D.C.: National Academies Press. xii, 254 p.



Introduction

Global climate change has become one of the most visible environmental concerns of the 21st century. From pictures of polar bears clinging to melting ice floes in Alaska to dried and cracked farmland stretching into the horizon in Africa, images of the ecological impacts of climate change have become part of our combined consciousness and inspire concern and discussion about what climate change ultimately will mean to our planet. But seldom are the effects of climate change expressed, either visually or otherwise, in terms of the real and potential costs in human lives and suffering. To date, most climate change research has focused on environmental effects and not health effects. It is clear that climate change endangers human health, but there is need to improve the science and knowledge base of how it occurs. One purpose of this document is to identify research gaps to increase the understanding of climate change and health. Expanding our understanding of the often indirect, long-term, and complex consequences of climate change for human health is a high priority and challenging research task.⁵ In the developed world particularly, there is perhaps a greater perception of the ecological and environmental effects of climate change than of the human health implications. This may be due in part to the fact that images linking climate change and some already apparent wildlife and landscape effects are prevalent, and thereby, increase concern.

⁵ National Research Council (U.S.). Committee On Health, E, And Other External Costs And, et al. Board on Environmental Studies and Toxicology special report. 2009, Washington, D.C.: Board on Environmental Studies and Toxicology.

There is no doubt, however, that climate change is currently affecting public health through myriad environmental consequences, such as sea-level rise, changes in precipitation resulting in flooding and drought, heat waves, changes in intensity of hurricanes and storms, and degraded air quality, that are anticipated to continue into the foreseeable future. In a tally that included just four diseases (cardiovascular disease, malnutrition, diarrhea, and malaria) as well as floods, the World Health Organization (WHO) estimated 166,000 deaths and about 5.5 million disability-adjusted life years (DALYs, a measure of overall disease burden) were attributable to climate change in 2000.⁶ To date, the majority of analyses on climate change and health have focused on diseases that predominantly affect people in the developing world, and therefore, are perceived as less relevant to more developed countries. However, as the recent pandemic of H1N1 virus has shown us, diseases do not respect international boundaries. Climate change can be a driver for disease migration, but even so, such diseases do not represent the broadest range of possible, or even likely, human health effects of climate change, nor do they reflect the likely co-benefits of mitigation and adaptation to climate change, some of which may have their greatest impact in the developed world.

For over 170 years, scientists have studied the complicated relationship between the weather, climate, and human health.⁷ Since the first attempt at scientific consensus on climate change nearly four decades ago,⁸ scientists have been examining whether climate is indeed changing as a result of human activity. However, the complicated relationships between climate change, the environment, and human health have not represented high priorities for scientific research in the United States, and there are abundant gaps in our understanding of these links.⁹ Such gaps impair our ability to identify optimal strategies for mitigation and adaptation that will prevent illness and death in current human populations while simultaneously protecting the environment and health of future generations. The purpose of this report is to identify the major research areas that need to be further explored and understood, and to identify the scientific capacities that will be needed to adequately address the problems that arise at the nexus of climate, environment, and human health with the goal of informing federal agencies with a human health or related research mission as they approach these daunting challenges.¹⁰ Research outcomes generated from the needs agenda outlined here would go a

long way toward informing health decision making and addressing the challenges outlined in the National Research Council's report.¹¹

Leaders including the Director, National Institute of Environmental Health Sciences (NIEHS); the Chief Scientist in the Office of the Science Advisor, U.S. Environmental Protection Agency (EPA); the Senior Scientist for Coastal Ecology, National Oceanic and Atmospheric Administration (NOAA); and the Director, National Center for Environmental Health, Centers for Disease Control and Prevention (CDC) initiated the development of this white paper in February 2009. The Interagency Working Group on Climate Change and Health (IWGCCCH) was established with representation and participation from various federal agencies, institutes, and other organizations with an environmental health or public health mandate. (Participating groups are listed on the Working Group page of this document, pp. iii). The first activity of this ad hoc group was to review and distill the state of the science on the effects of climate change on human health from the many excellent reviews of climate change already published by groups including the Intergovernmental Panel on Climate Change, the World Health Organization, the U.S. Global Change Research Program, the National Research Council, and others. Most of these reports take a much broader view of the issue of climate change; however, the portions that are directly relevant to human health effects provided a critical baseline from which this working group could proceed to identify the research gaps and needs in this area.

This document does not attempt to be a comprehensive assessment of the risks associated with climate change and health or a strategic plan. Rather it seeks to build on the existing knowledge of the prior efforts, and extend this knowledge further by shifting the perspective on climate change effects from a largely ecological and meteorological base to one that focuses on the human health consequences of climate change, mitigation, and adaptation. Similarly, an aim of this report is to inform the federal government as it seeks to focus climate change research on understanding the interactions among the climate, human, and environmental systems and on supporting societal responses to climate change. In this way, it is responsive to the recommendations of some of these reports. The working group has drafted this document in consultation with subject matter experts at the various agencies, seeking their review and comment throughout the process to provide a concise, credible, and broad discussion.

6 Campbell-Lendrum, D, et al. Environmental Burden of Disease Series, ed. A Pruss-Ustun, et al. 2007. Geneva: World Health Organization. 66.

7 Duglison, R. 1835, Philadelphia.; Carey, Lea & Blanchard. xi, [13]-514 p.

8 Study of Critical Environmental Problems., et al. 1970, Cambridge, Mass.; MIT Press. xxii, 319 p.

9 Campbell-Lendrum, D, et al., The Lancet, 2009. 373(9676): p. 1663-1665.

10 Gamble, JL, et al. 2008, Washington, D.C.: U.S. Climate Change Science Program. ix, 204 p.

11 National Research Council (U.S.). Committee on Strategic Advice on the U.S. Climate Change Science Program., et al. 2009, Washington, D.C.: National Academies Press. xii, 254 p.

Figure 1 provides the conceptual framework used to develop this report. In addition to the direct effects of heat on humans, the major impacts of climate change on human health are through changes to the human environment such as rising oceans, changing weather patterns, and decreased availability of fresh water. Mitigation of climate change refers to actions being taken to reduce greenhouse gas emissions and to enhance the sinks that trap or remove carbon from the atmosphere to reduce the extent of global climate change. Adaptation refers to actions being taken to lessen the impact on health and the environment due to changes that cannot be prevented through mitigation. Appropriate mitigation and adaptation strategies will positively affect both climate change and the environment, and thereby positively affect human health. In addition, some adaptation activities will directly improve human health through changes in our public health and health care infrastructure. Gaps in our understanding of how human health, climate change, the environment, and mitigation and adaptation are linked are the focus of this report.

Figure 2 expands upon the conceptual framework in **Figure 1**, and provides a global view of the complex ecological networks that can be disrupted by climate change, the human health implications of such disruptions, and the targets of mitigation and adaptation. Many

of these diseases¹² and disorders are not independently affected; any one disease is likely to have several drivers from the group of environmental consequences that result from climate change, and conversely, any particular environmental change could affect multiple disease categories. In addition, both positive and negative synergies will occur among various components of the system.

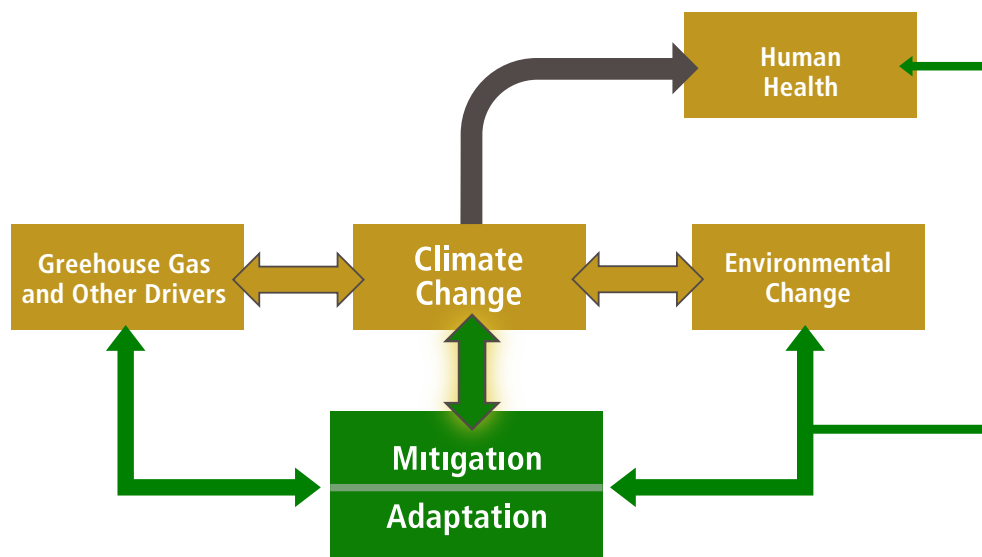
Climate change directly affects five components of the environment: water, air, weather, oceans, and ecosystems.¹³ Changes in rainfall and other precipitation, changing temperatures, and melting of summer ice caps are already occurring and will create changes in the availability and quality of water across much of the planet over the next 30 years.¹⁴ In the United States, water security, or the reliable availability of water for drinking, agriculture, manufacturing, and myriad other uses, is becoming a pressing issue. This is particularly true in the Western half of the country, where water shortages are exacerbated by reduced mountain snowpack due to warming, and in the South, where severe droughts have become a more frequent occurrence in recent years. Water quality is also affected in many regions, particularly coastal areas, due to extreme weather events

12 For simplicity, we will use disease to include the broad spectrum of human diseases, syndromes, ailments and conditions being described here.

13 Intergovernmental Panel on Climate Change. Working Group II. 2007, Cambridge: Cambridge University Press. ix, 976 p, Karl, T, et al. 2009, New York: Cambridge University Press.

14 Intergovernmental Panel on Climate Change. Working Group II. 2007, Cambridge: Cambridge University Press. ix, 976 p.

FIGURE 1 | Changes in greenhouse gas concentrations and other drivers change our global climate altering human health; mitigation alters climate and both mitigation and adaptation alter the human environment; the predominant impact on human health is through environmental changes as a result of climate change although there are direct impacts from both climate changes and mitigation/adaptation.



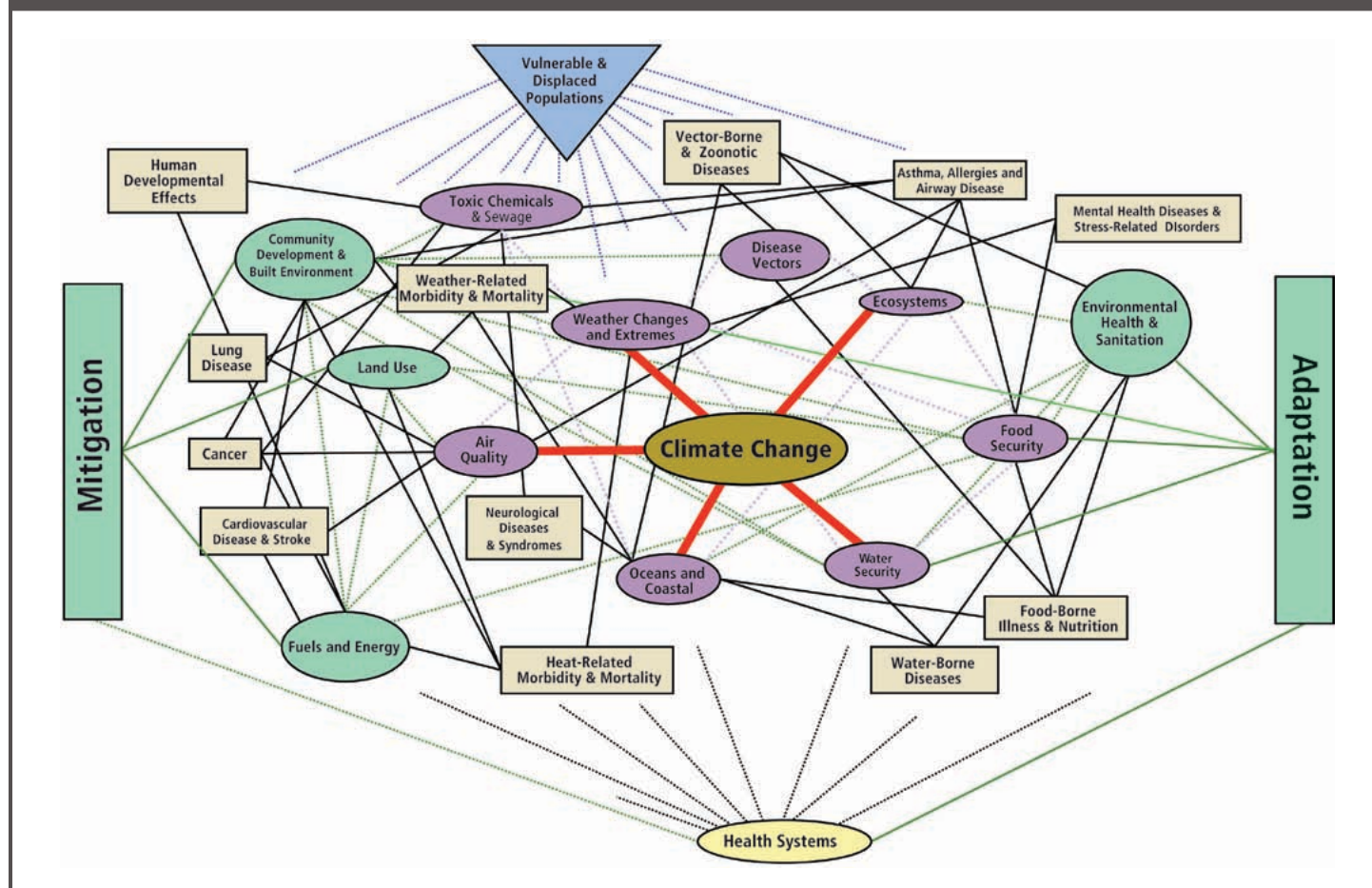
such as hurricanes and flooding. These same events, often associated with sea-level rise and increased storm surges, can heavily damage human communities and alter complex coastal ecosystems with consequences for both water and food quality and supply.

The complex atmospheric chemistry that governs air quality is modulated by heat, humidity, degree of ultraviolet (UV) radiation, and many other factors. Changes in any of these can directly reduce air quality, particularly in urban areas, by increasing air concentrations and human exposures to a variety of toxic air pollutants including chemicals, fungi, and aeroallergens. In many areas of the country, climate change and resulting weather events such as drought and wildfires will reduce general air quality and increase

human exposure to a variety of pollutants, with resulting increases in asthma, cardiovascular disease, and other respiratory ailments.

Some of the human health effects will arise from extreme weather events that are expected to become more common in a warmer climate. For instance, more intense hurricanes and increases in flooding and wildfires may exacerbate a wide range of health effects resulting from the release of toxic chemicals from landfills, contamination of drinking water with raw sewage as a result of damage to water infrastructure, increased concentrations of air pollutants that are especially harmful to susceptible populations such as children, the elderly, and those with asthma or cardiovascular disease, and myriad other hazards associated with these events. Extreme heat

FIGURE 2 | Climate change has direct impacts on five aspects of the human environment (red lines, purple circles) that in turn impact additional environmental factors. These environmental changes then alter twelve separate aspects of human health (tan boxes). Mitigation and adaptation alter the human environment in order to address climate change and, in this way, alter human health. Finally, susceptible populations exist for all climate-targeted health points, and the health systems play an integral role in addressing the health concerns driven by climate change.



also directly increases the risk of injury, illness, and death, as well as indirectly by contributing to illnesses such as those associated with mental health and stress.¹⁵

Global climate change is visibly and profoundly affecting oceans, which in turn, affects human health. The warming of ocean waters contributes to increases in incidence and severity of toxic algal blooms, alterations in aquatic and estuarine food webs and seafood quality and availability, and effects on sentinel aquatic species¹⁶. High concentrations of carbon dioxide in the atmosphere increase the amount that is dissolved into the ocean, leading to acidification and disruption of ecosystems. As large portions of the world's populations, including those in the United States, live in coastal areas, and many depend on marine protein for daily subsistence, the consequences of perturbing delicate ocean and coastal systems will be far-reaching.

Climate changes including increased heat in certain arid and semi-arid parts of the United States can dramatically alter existing ecosystems, presenting new challenges to agricultural production and coastal ecosystems, with consequences for food quality and availability. Changes in plant habitat can result in reduced availability of grazing lands for livestock.¹⁷ Climate changes also are directly associated with many pest habitats and disease vectors, and changes in temperature can extend or reorient habitats such that organisms are introduced to new geographic areas or life cycles are altered, requiring increases in pesticide use or use in new areas to achieve the same yields. Global warming is also causing shifts in the ranges of disease vectors that require specific environments to thrive (for example, Lyme disease),¹⁸ and increasing the threat and incidence in humans of waterborne, vectorborne and zoonotic (those transferred from animals to humans) diseases.

No current mitigation strategy or technology can prevent the change in climate that has already occurred. At present, our ability to mitigate the magnitude of the climate changes that will occur over the next 100 years is limited by the current makeup of the atmosphere, as well as what we can prevent from entering and what we are able to remove from the atmosphere in the future. The major targets of climate change mitigation strategies include alternative fuels and energy conservation, changes in land use patterns, sustainable development of the built environment, and carbon capture and storage.¹⁹ Switching from fossil fuels and other greenhouse

gas-emitting energy sources to cleaner alternatives and using carbon capture and storage technologies will slow the rate at which we release greenhouse gases into the environment. Energy conservation and modifications in energy use will also reduce releases. Land use changes such as restricting the destruction of forests and replanting more trees will serve to increase natural carbon storage.

Actions to preserve other ecosystem services, such as flood control by protecting wetlands or vector control by conserving biodiversity, can also reduce the severity of climate change-related problems.²⁰ Finally, changes in building codes, transportation infrastructure, housing density, coastal development, and other urban planning strategies can reduce energy usage and thereby mitigate some portion of climate change. Through these changes in human activities and practices, we should be able to limit the magnitude of the changes to the planet's climate, and thus, reduce the negative impacts to human health. Though it is possible that some mitigation strategies may exacerbate known human health stressors or introduce unanticipated potential for human harm, many strategies will provide co-benefits, simultaneously reducing the negative effects of climate change while also reducing illness and death. For example, reducing harmful air pollutants generally decreases global warming but is also just more healthful to people.²¹

Recognizing that there are a broad set of issues related to both potential benefits and possible adverse effects on human health resulting from mitigation and adaptation strategies, the IWGCC did not attempt to outline research needs for mitigation and adaptation in a comprehensive manner in this report, nor provide a comprehensive overview of mitigation and adaptation approaches. These issues and their associated research needs will have to be evaluated in the context of the individual options and strategies. Instead, this report focuses on some of the broader mitigation and adaptation options that are currently under development that have the potential to provide great benefits to human health and proposes research needs that could inform decisions relating to them, and examples of mitigation and adaptation needs related to certain health consequences are included within each chapter.

Adapting to or coping with climate change will become necessary in the United States and around the world. Most adaptation strategies seek to change the human environment and decrease the potential for illness and death by helping to prevent some of the worst consequences of climate change. The primary environmental factors targeted for adaptation are water security and food security.

15 Noyes, PD, et al., *Environment International*, 2009. 35(6): p. 971-986.

16 United States. Congress. Senate. Committee on Commerce Science and Transportation. 2003, Washington: U.S. G.P.O. ii, 8 p.

17 Ericksen, PJ, et al., *Environmental Science and Policy*, 2009. 12(4): p. 373-377.

18 Estrada-Peña, A, *Environ Health Perspect*, 2002. 110(7): p. 635-40.

19 Haines, A, et al., *Lancet*, 2006. 367(9528): p. 2101-2109.

20 Corvalán, C, et al. 2005, [Geneva, Switzerland]: World Health Organization. 53 p.

21 Smith, KR, et al., *Lancet*, 2009.

Given the likely changes that will occur in precipitation patterns, temperature, and extreme weather events, adapting the ways in which we store, treat, and use water will be key to avoiding changes in water security. Similarly, food sources—whether they be crops, livestock, marine, or freshwater—will be under greater stress in various parts of the United States, and as a nation we need to develop adaptation strategies to ensure our food security. Clean water and access to sufficient safe food are fundamental needs for human health, so successful adaptation methods that maintain and improve the availability of clean water and healthy food will be critical to avoiding some of the major health impacts of climate change. There is also a need for adaptation strategies focused on community development and the built environment, transportation, and public health infrastructure.²²

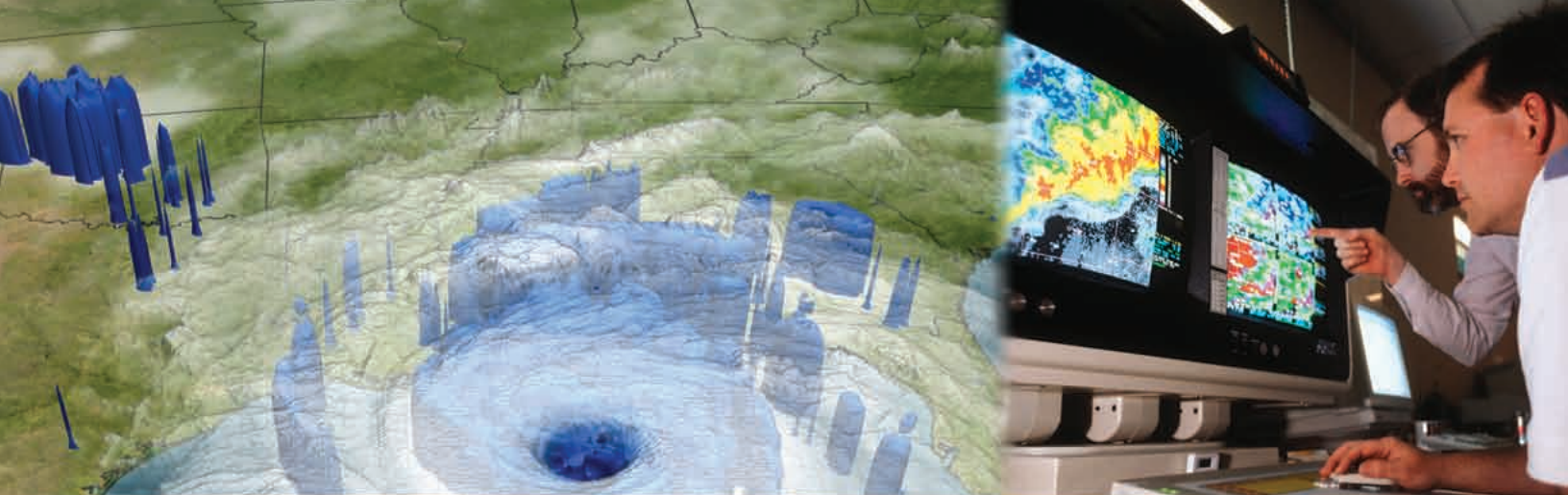
Through these environmental changes, increases—and in some rare cases—decreases in adverse human health consequences are likely to occur. We have organized these health consequences into 11 broad categories for discussion (listed below). In this report, we provide for each category a brief synopsis of what is known about the relationship between climate change; mitigation, and adaptation; effects on the risk, incidence, severity, or characteristics of the specific diseases or disorders; the major research needs and questions that must be addressed; and in some cases, an indication of the specific skills and capacities that will be needed to facilitate the research. Because factors including urgency, likelihood of occurrence, numbers of people affected, severity of effects, and economic issues associated with each category are broad, difficult to quantify, and largely beyond the mandate of our individual agencies, we have deliberately chosen not to attempt a prioritization of the research needs, but rather seek to provide a body of knowledge to inform federal agencies, and the government as a whole, as agencies and other groups set their own priorities and agendas in this area. The scope of this analysis is largely confined to examining effects on the U.S. population, which is the primary constituency of the federal agencies, recognizing that most, if not all, of these issues are of global concern and consequence as well, and in the hopes that resulting gains from this information can be applied to global collaborations in the future. Similarly, although we attempt to provide some discussion of the training, capacities, technology, and infrastructure needs that will be required to address these critical research questions, it is within the context and for the purpose of identifying and applying those resources present or anticipated within our specific federal agencies.

Finally, the health consequence categories, although treated as individual topics, are not discrete, but rather are connected through the complicated systems within our planet and our own bodies. We have tried to draw out these connections wherever possible and when they are of major significance. We also have identified a number of crosscutting issues that are critical to this discussion including susceptible, vulnerable, and displaced populations; public health and health care infrastructure; capacities and skills needed; and communication and education to increase awareness of climate change health effects.

Categories of human health consequences of climate change:

1. Asthma, Respiratory Allergies, and Airway Diseases
2. Cancer
3. Cardiovascular Disease and Stroke
4. Foodborne Diseases and Nutrition
5. Heat-Related Morbidity and Mortality
6. Human Developmental Effects
7. Mental Health and Stress-Related Disorders
8. Neurological Diseases and Disorders
9. Vectorborne and Zoonotic Diseases
10. Waterborne Diseases
11. Weather-Related Morbidity and Mortality

22 Haines, A, et al., *Ibid.* 2006. 367(9528): p. 2101-2109.



Crosscutting Issues for Climate Change and Health

In the process of identifying and characterizing research needs on the health implications of climate change for the 11 categories of consequences, it became evident that multiple crosscutting issues span all aspects of the research needs. In the sections below, we briefly summarize the major areas of overlap.

Susceptible, Vulnerable, and Displaced Populations. The World Health Organization defines “environment” as “all modifiable physical, chemical, and biological factors external to the human host, and all related behaviors that are critical to establishing and maintaining a healthy livable environment.”²³ Within this definition, it is likely that the environment can affect most human diseases and illnesses. There are certain populations that are at increased risk from environmental factors that affect health, and such populations present unique concerns when considering the health risks from climate change. “Susceptibility” refers to intrinsic biological factors that can increase the health risk of an individual at a given exposure level. Examples of susceptibility factors that have been shown to increase individual health risks are certain genetic variants, life-stage such as childhood, and medical history such as a prior history of disease. “Vulnerability” refers to human populations at higher risk due to environmental or personal factors. For example, people living in mud brick houses in earthquake zones are much more vulnerable to injury from building collapse than those living in structures built with modern techniques and stronger materials. Populations living in poverty, substance abusers, and those with mental illness are at increased vulnerability to many of the environmental changes resulting from climate change. Another form of vulnerability is seen in displaced populations, who have been shown to be at higher risk of a number of diseases, including diarrheal and vectorborne diseases resulting from exposure to poor sanitation, as well as mental health illnesses due to increased acute and chronic stress.²⁴

Populations with both susceptibility and vulnerability factors are referred to as “sensitive” populations. An example of a sensitive population would be certain members of the displaced population that evacuated New Orleans following Hurricane Katrina. Studies have shown that within this population, older people (susceptible)

who were of low income (vulnerable) were the slowest to recover from the disaster.²⁵ Virtually every human disease is likely to have both susceptible and vulnerable populations associated with it. One key aspect to mitigating the effects of climate change is a better understanding of diseases and the unique risks of various exposed or affected populations so that strategies may be developed that take such risks into account and are tailored to address them.

In the case of diseases linked to climate change, a number of populations are particularly at risk. Children, pregnant women, and the elderly are generally more susceptible, especially for heat- and weather-related illness and death, vectorborne and zoonotic diseases, and waterborne and foodborne illnesses.²⁶ Also, children and some minority groups are very susceptible to asthma and allergies that may be exacerbated by climate change. Genetic links and markers that help to identify and define susceptible populations exist for many climate-related diseases.

Poverty generally makes people more vulnerable to many of the health effects of climate change, largely due to inadequate access to health care. Poverty also increases the risk that a population displaced by extreme weather events or environmental degradation will not easily recover, and as a result, will suffer much higher disease risks. The same is true for people who abuse drugs, those who suffer mental illness, and others who for various reasons are socially isolated. For such populations, the effects of climate change such as temperature and weather extremes, disruptions in access to public services including health care and food assistance programs, and increased stress are all magnified by their preexisting conditions or situations. Outdoor workers and people living in coastal and riverine zones also are likely to experience increased vulnerability to climate-induced environmental changes resulting from flooding and extreme weather events.

Data to support a broad understanding of which populations will be most susceptible and vulnerable to diseases affected by climate change are generally lacking at this time; however, data are

23 Prüss-Ustün, A, et al. 2006. Geneva, Switzerland: World Health Organization. 104 p.
24 Myers, N, *Philos Trans R Soc Lond B Biol Sci*, 2002. 357(1420): p. 609-13.

25 Eisenman, DP, et al., *Am J Public Health*, 2007. 97 Suppl 1: p. S109-15.

26 Balbus, JM, et al., *Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine*, 2009. 51(1): p. 33-37.

available that identify vulnerable populations for some diseases with environmental causes or triggers that are likely to be altered by climate change. For example, reducing vehicle emissions may mean that populations living near freeways, who are at higher risk of cardiovascular disease, asthma, and spontaneous abortion, may see a reduction in incidence of these effects.²⁷ Expanding research on these diseases to incorporate effects of climate change will help to identify vulnerable populations, and also to develop the strategies needed to adapt to climate changes and avoid excess health risks. These research efforts, if they are to be effective, must involve a broad spectrum of research scientists from epidemiologists and physicians to environmental engineers and community planners. Such efforts also will require a broad-based, multi-agency federal program that builds on the strengths of each agency to develop an overall comprehensive research agenda.

Public Health and Health Care Infrastructure. The term “public health” describes the science of preventing disease, prolonging life, and promoting health and its application to society, communities, and groups. In contrast, “health care” primarily focuses on the treatment of illness and the protection of mental and physical well being in individuals through services provided by physicians and other health care professionals. Together, these two areas are tasked with the protection of the health of the people of the United States.

Public health agencies exist across the United States in most large cities, as well as at the county, state, and federal levels. Schools of public health and other training and research institutions add to the total public health infrastructure investment of the United States, which is very large and quite complex. The public health system will play a critical role in the prevention of human disease from climate change. As such, public health agencies should be deeply involved in researching, developing, and implementing adaptation strategies to climate change. There is a critical need for research to understand how climate change will alter our public health needs in the United States, and to design optimal strategies to meet those needs.²⁸

The health care delivery infrastructure in the United States is even more diverse and complicated than the public health infrastructure (though there are multiple overlaps between the two systems). From family doctors in small towns to complex university research

hospitals in large cities, health care professionals are the primary source of medical treatment, prenatal and pediatric care, and individual health protection and promotion for people in the United States. But this infrastructure is also vulnerable to climate change in a number of very important ways. Disasters can severely hinder the delivery of health care, with long-term impacts.²⁹ Changes in the numbers of patients and the spectrum of diseases with which they present could occur in some regions as the climate changes. The types of advice offered to patients with chronic conditions and the infrastructure to support them may need to be adapted to protect against climate-induced changes that may make these individuals more vulnerable. Currently there is limited research to guide these types of decisions.

The public health community is in the early stages of developing modeling skills and capacity in relation to climate change, particularly for combining climate models with ecological and other health outcome models for use in projecting disease dynamics under various climate scenarios. In order to understand these dynamics, a sustained surveillance infrastructure that integrates human and ecological health (terrestrial, marine, aquatic) is critical. While the public health community has developed considerable expertise in behavioral science and health education, this expertise has yet to be applied to the most trenchant issues related to climate change.

Sea-level rise, coastal erosion, and population displacement will create challenges for public health infrastructure that has been constructed over a period of hundreds of years. Disruption of coastal routes and harbors by sea-level rise will present additional challenges to health care delivery and food distribution. It is doubtful that transportation infrastructure will be able to adapt quickly enough to large population shifts that may be made in response to changes in rainfall patterns. Displaced populations will need sewer and water resources in new locations. The sewer and water resources in coastal locations may be threatened directly by sea-level rise.

Capacities and Skills Needed. Many of the existing skills used in public health and health care are well established and applicable to dealing with the health effects of climate change, but new skills will also be needed. Skills used in certain types of disease surveillance are well established. Less well established are the skills and methods needed to integrate current and future surveillance activities

27 Clougherty, JE, et al., *Environ Health Perspect*, 2009. 117(9): p. 1351-8; Green, RS, et al., *Environ Health Perspect*, 2009. 117(12): p. 1939-44.

28 Bedsworth, L, *Environmental Health Perspectives*, 2009. 117(4): p. 617-623.

29 Rudowitz, R, et al., *Health Aff (Millwood)*, 2006. 25(5): p. w393-406.

and retrospective datasets with weather and climate information. Understanding of how to conceptualize and conduct epidemiological analysis using weather and climate as exposures is also preliminary. Methods and skill in combining spatial epidemiology with ecological approaches are also lacking. There is a strong need for the ability to translate vulnerability mapping and health impact assessments (HIAs) into behavioral changes and effective public health actions.

A greater emphasis must be placed on developing and maintaining interdisciplinary and inter-institutional collaborations, as well as on ensuring that established resources and expertise of all of the relevant disciplines, including climatology, modeling, environmental science, risk assessment, public health, and communications and education, are applied to these pressing problems. Many additional disciplines including ecology, social science, economics, geography, behavioral psychology, and others will need to play a vital role in climate and health decision making.

Communication and Education. Other areas where public health professionals may contribute robustly to efforts to address the impacts of climate change are in communication and education. Public health educators have a strong history of promoting health and wellness through educating individuals and communities about healthy behaviors and disease prevention or management. The same skills are critical to helping raise awareness of the potential impacts of climate change, and translating the scientific research and other technical data into credible and accessible information for the public to use in making informed decisions that will protect their health and the environment.

Recent studies show that the majority of those living in the United States now believe that climate change is a real and serious threat that is caused by human activity. However, research is still needed to determine how to effectively educate and organize the public to respond.³⁰ This is complicated by recent research showing that various audiences within the American public respond to the issue of climate change each in their own distinct way.³¹ Research is needed that will aid climate change communicators and educators in adapting their messages and approaches to most appropriately and effectively reach and be assimilated by each individual audience.

In addition to the general public, other audiences—each with their own culture and means of acquiring information—also require effective communication on issues of climate change. Stakeholders such as natural resource managers, policy makers, infrastructure planners, health care providers, and others also need access to credible and timely climate change information to inform their decision-making.

Protecting human health is an issue that crosses institutional, scientific, and political boundaries. In the United States, no single institution at the local, regional, or federal level can fully protect public health without cooperation from other institutions. In addition, no single scientific field is capable of accomplishing all aspects of the research needed to understand the human health consequences of global climate change; such an endeavor will require a broad-based, trans-disciplinary research portfolio. And in our global society, the highly integrated activities of individuals around the world mean that no one country can be solely responsible for addressing the health impacts of global climate change. Through the process of developing this white paper, it rapidly became clear that identifying research needs; mobilizing and creating the expertise, resources, tools, and technologies to address them; and translating these efforts into solutions that will enable human adaptation to our changing environment while protecting public health will require collaborations on an unprecedented scale. Such collaborations should build on the strengths and capacities of individual organizations in ways that maximize the efforts of the group toward these shared goals.

30. Leiserowitz, A. et al., Climate change in the American mind: Americans' climate change beliefs, attitudes, policy preferences, and actions. 2009, Yale Project on Climate Change, School of Forestry and Environmental Sciences: New Haven, Connecticut. p. 56.

31. Maibach, E. et al., Global warming's six Americas 2009: An audience segmentation analysis. 2009, George Mason University Center for Climate Change Communication: Washington, DC. p. 140.



1

Asthma, Respiratory Allergies, and Airway Diseases

Allergic diseases, including asthma, hay fever, rhinitis, and atopic dermatitis, impact approximately 50 million individuals within the United States and are associated with significant health care costs and lost productivity.³² In the early 1990s, the United States attributed health care costs of \$11 billion to all respiratory disease with an estimated loss of 3 million workdays and 10 million schooldays.³³ Asthma is the second leading cause of chronic illness among children and is rapidly rising among children less than five years of age; however, the prevalence of asthma is highest among adults.³⁴ Incidence rates of asthma and other respiratory allergic diseases are often difficult to obtain; however rates of prevalence and disease exacerbation show a disproportionate trend along certain socioeconomic lines. Hospitalization rates, emergency department use, disability and death are often highest among children, African American and Hispanic populations, persons living in the inner city, and the poor.³⁵

In recent decades, the world has seen a sharp rise in prevalence as well as severity of such respiratory diseases. The incidence of respiratory diseases grew markedly in the United States over the last several decades but has begun to plateau in recent years. Some experts speculate that the global rise in asthma was indirectly related to climate change.³⁶ Many respiratory allergic diseases are seasonal with climate sensitive components; climate change may increase the incidence and exacerbation of such allergic diseases. While some risk for respiratory disease can be clearly linked to climate change, for many others the risk attributable to climate change is unclear. Given the prevalence of these diseases and the significant disease burden imposed by asthma and respiratory allergic disease, further research into the impacts of climate change on these diseases should be a high priority.

Management of asthma and other respiratory allergic diseases relies on several factors including strict control of exacerbation triggers of the diseases. Although not all asthmatic episodes are triggered by environmental factors, a significant number are, including factors such as ambient air pollutants, allergens, stress, and a host of other

environmental variables. As a result, changes to environment may adversely impact the severity of climate-sensitive diseases.

In addition to impacts on asthma and other allergic diseases, climate change has the potential to impact airway diseases by increasing ground level ozone and possibly fine particle concentrations. Breathing ozone can trigger a variety of reactions including chest pain, coughing, throat irritation, and congestion; and can worsen bronchitis, emphysema, and asthma. Exposure to ground-level ozone can also reduce lung function and inflame the linings of the lungs; repeated exposure may permanently scar lung tissue.³⁷ Fine particles (fewer than 2.5 micrometers in diameter, or PM_{2.5}) contain microscopic solids or liquid droplets that are so small that they can get deep into the lungs where they cause serious health problems. Numerous scientific studies have linked exposure to fine particle pollution to a variety of health problems including increased respiratory symptoms (irritation of the airways, coughing, difficulty breathing), decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with heart or lung disease.³⁸

Impacts on Risk

Climate change will affect air quality through several pathways including production and allergenicity of aeroallergens such as pollen and mold spores and increases in regional ambient concentrations of ozone, fine particles, and dust. Some of these pollutants can directly cause respiratory disease or exacerbate respiratory disease in susceptible individuals.

Earlier flower blooming resulting from temperature increases and increased carbon dioxide (CO₂) concentrations affects timing of distribution of aeroallergens such as pollen through plant photosynthesis and metabolism.³⁹ There is also a possibility that certain aeroallergens may become more allergenic as temperatures and CO₂ concentrations increase.⁴⁰ Precipitation-affected aeroallergens such as mold spores also are of concern, as 5% of individuals are predicted to have some respiratory allergic airway symptoms from molds over their lifetime.⁴¹

32 Bytowski, JR, et al., *Curr Sports Med Rep*, 2003. 2(6): p. 320-4.

33 Smith, DH, et al., *Am J Respir Crit Care Med*, 1997. 156(3 Pt 1): p. 787-93; Weiss, KB, et al., *N Engl J Med*, 1992. 326(13): p. 862-6.

34 Benson, V, et al., *Vital Health Stat* 10, 1998(190): p. 1-428.

35 Mannino, DM, et al., *MMWR CDC Surveill Summ*, 1998. 47(1): p. 1-27A

36 D'Amato, G, et al., *Clinical and Experimental Allergy*, 2008. 38(8): p. 1264-1274.

37 Uysal, N, et al., *Curr Opin Pulm Med*, 2003. 9(2): p. 144-50.

38 Kreyling, WG, et al., *J Aerosol Med*, 2006. 19(1): p. 74-83.

39 Stitt, M, *Plant Cell and Environment*, 1991. 14(8): p. 741-762.

40 Cassassa, G, et al. 2007, Cambridge: Cambridge University Press, Rogers, CA, et al., *Environmental Health Perspectives*, 2006. 114(6): p. 865-869; Shea, KM, et al., *Journal of Allergy and Clinical Immunology*, 2008. 122(3): p. 443-453; Vose, RS, et al., *Nature*, 2004. 427(6971): p. 213-214; Wan, SQ, et al., *American Journal of Botany*, 2002. 89(11): p. 1843-1846; Ziska, LH, et al., *Global Change Biology*, 2005. 11(10): p. 1798-1807.

41 Hardin, BD, et al., *J Occup Environ Med*, 2003. 45(5): p. 470-8.

In the presence of certain air emissions, the rate of ozone formation increases with higher temperatures and increased sunlight, and can also be affected by changes in storm tracks, humidity, and stability of the boundary layer (lowest part of the atmosphere).⁴² Humidity and temperature also partly determine the formation of PM_{2.5}. Research studies associate fine particles with negative cardiovascular outcomes such as heart attacks, formation of deep vein blood clots, and increased mortality from several other causes.⁴³ These adverse health impacts intensify as temperatures rise.⁴⁴ Studies also link elevated exposure to ground-level ozone, PM_{2.5}, coarse thoracic PM, and aeroallergens to decreased lung function, aggravation of asthma, rhinitis, exacerbations of chronic obstructive pulmonary disease, hospitalizations for respiratory and cardiovascular diseases, and premature mortality.

Air pollution overcomes the mucosal barrier in lungs by inducing airway inflammation, which results in allergen-induced respiratory responses.⁴⁵ In addition, air pollutants such as PM_{2.5} and ozone may alter the allergenicity of aeroallergens like pollen, thereby promoting further airway sensitization.⁴⁶ The triggers for such adverse respiratory responses vary and include climatic factors (meteorological events, rainfall patterns, and temperature anomalies), high levels of vehicle emissions, land-use patterns, variables in the built environment, geography, and distance from roadways.⁴⁷ Physiology also plays a significant role, as individuals with existing respiratory conditions are most vulnerable to disease exacerbations triggered by the environment.⁴⁸ The populations most vulnerable to the increased disease risks include children, pregnant women, persons of low socioeconomic status, persons situated near high traffic zones within urban centers, and those with preexisting respiratory and cardiovascular diseases.

Other airborne exposures are also likely to worsen with climate variability and change. Changes in the hydrologic cycle with increasingly variable precipitation and more frequent drought may also lead to a global increase of airborne dust, which, when coupled with anticipated stagnant air masses and increasingly strong inversion layers, will trap ozone and other airborne pollutants near the ground causing exacerbations of respiratory disease. Coarse thoracic PM (between 2.5 and 10 micrometers in diameter) is associated with increased risk of emergency department visits and hospitalizations for cardiovascular outcomes, especially among

adults over 65 years of age.⁴⁹ Increased incidence of wildfires in some areas can also contribute to PM concentrations. In certain areas airborne dust serves as a carrier of specific diseases, such as coccidioidomycosis, or “valley fever,” in the desert Southwest, the incidence of which has increased in recent years.⁵⁰ Prolonged drought will lead to more dust and particulate pollution while increased rainfall will cleanse the air but may create more mold and microbial pollution. In addition, drought, declining water quality, and increased temperatures contribute to the growth of harmful algal blooms that produce toxins that can be aerosolized and exacerbate asthma and respiratory diseases.⁵¹

Despite strong evidence of associations between a wide range of environmental variables impacted by climate and respiratory disease, the direct impacts of climate change on asthma, respiratory allergies, and airway diseases need further study to evaluate the fraction of respiratory disease risk that can be attributed to climate change and potentially mitigated or avoided.

Mitigation and Adaptation

Mitigation and adaptation strategies have the potential to both positively and negatively affect human health. Reduction of vehicle miles traveled will reduce ozone precursors, thereby reducing the ozone associated with myriad respiratory health effects. Alternative transportation options such as walking and bicycling will reduce toxic emissions while providing positive benefits for health such as increasing cardiovascular fitness and contributing to weight loss (although such activities also have the potential to increase exposure to harmful outdoor air pollutants, particularly in urban areas, simply by virtue of increased time spent outdoors).⁵² Mitigation of short-lived contaminant species that are both air pollutants and greenhouse gases is gaining momentum.⁵³ For example, controlling ozone or black carbon could bring short-term climate benefits and alleviate a fraction of the current health burden from these pollutants. Urban tree cover has been shown to reduce ambient concentrations of ozone, PM, and other pollutants.⁵⁴ Significant co-benefits of urban vegetation include shade, which reduces the heat-island effect and decreases energy required to cool buildings, and a concomitant reduction in greenhouse gas emissions.⁵⁵

42 Houghton, JT, et al. 2001. Cambridge ; New York: Cambridge University Press. x, 881 p.

43 Bytowski, JR, et al., *Curr Sports Med Rep*, 2003. 2(6): p. 320-4; Vose, RS, et al., *Nature*, 2004. 427(6971): p. 213-214; Baccarelli, A, et al., *Archives of Internal Medicine*, 2008. 168(9): p. 920-927; Confalonieri, U, et al. in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M Parry, et al., Editors. 2007. Cambridge University Press: Cambridge. p. 391-431; O'Neill, S, et al., *Occupational and Environmental Medicine*, 2007. 64(6): p. 373-379; Peters, A, et al., *Circulation*, 2001. 103(23): p. 2810-2815; Samoli, E, et al., *Environmental Health Perspectives*, 2008. 116(11): p. 1480-1486.

44 Qian, ZM, et al., *Environmental Health Perspectives*, 2008. 116(9): p. 1172-1178.

45 D'Amato, G, et al., *Clinical and Experimental Allergy*, 2008. 38(8): p. 1264-1274.

46 D'Amato, G, et al., *Respiratory Medicine*, 2001. 95(7): p. 606-611.

47 Shea, KM, et al., *Journal of Allergy and Clinical Immunology*, 2008. 122(3): p. 443-453.

48 D'Amato, G, et al., *Clinical and Experimental Allergy*, 2008. 38(8): p. 1264-1274.

49 Ballester, F, et al., *Gac Sanit*, 2006. 20 Suppl 1: p. 160-74; Le Tertre, A, et al., *J Epidemiol Community Health*, 2002. 56(10): p. 773-9; Zanobetti, A, et al., *Environ Health Perspect*, 2003. 111(9): p. 1188-93.

50 Komatsu, K, et al., *Journal of the American Medical Association*, 2003. 289(12): p. 1500-1502; Vugla, DJ, et al., *Journal of the American Medical Association*, 2009. 301(17): p. 1760-1762.

51 Abraham, WM, et al., *Environmental Health Perspectives*, 2005. 113(5): p. 632-637; Fleming, LE, et al., *Chest*, 2007. 131(1): p. 187-194.

52 Woodcock, J, et al., *Lancet*, 2009. 374(9705): p. 1930-43.

53 Smith, KR, et al., *ibid*.

54 Bowker, G, et al., *Atmospheric Environment*, 2007. 41: p. 8128-8139; Nowak, D, et al., *Urban Forestry and Urban Greening*, 2006. 4: p. 115-123.

55 Bolund, P, et al., *Ecological Economics*, 1999. 29: p. 293-301; McPherson, E, et al., *Urban Ecosystems*, 1997. 1: p. 49-61.

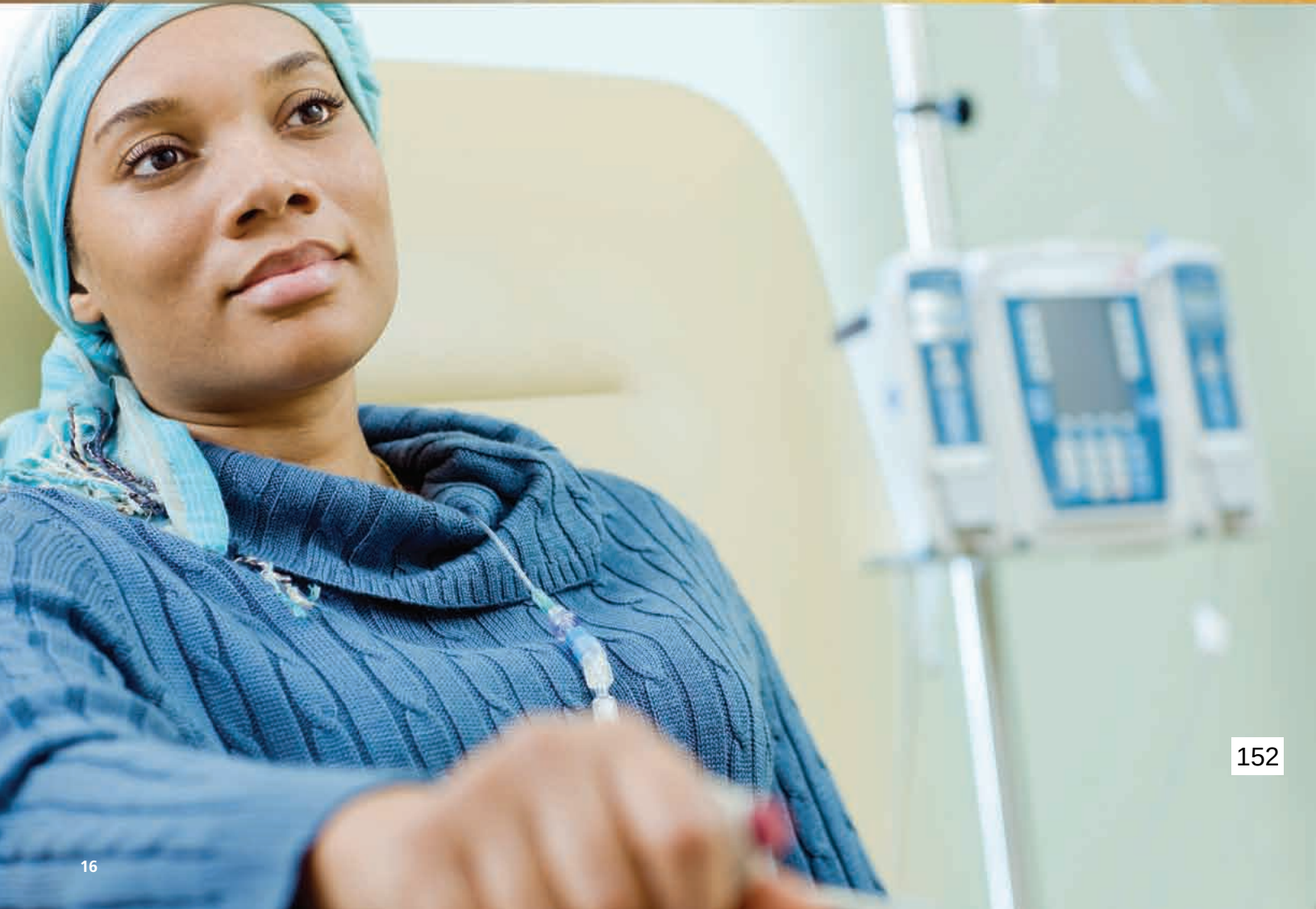
Adaptive measures such as increased use of air conditioning may alleviate some of the health effects associated with exposure to chronic or acute heat, but also can potentially result in higher greenhouse gas emissions and further declines in air quality, depending on the method of power generation. Health-based research to inform the use of novel fuel mixtures and electric vehicles will be important. Some impacts have been well characterized through life-cycle analyses, while others, particularly those related to novel fuels and energy sources, have yet to be assessed. Careful analyses of mitigation and adaptation co-benefits and tradeoffs are necessary so that appropriate strategies are adopted.

Research Needs

Climate change will likely amplify existing environmental stimulation of asthma, respiratory allergies, and airway disease, resulting in more severe and frequent disease exacerbations and an increase in the overall burden of these conditions. Thus, continued research on climate change's effect on alterations in the composition of aeroallergens and air pollutant mixtures and their consequent effects on health is essential. Research needs include:

- developing and validating real-time remote sensing and other *in situ* monitoring techniques to evaluate air quality, aeroallergens, aerosolized pathogens, dust burdens, and other climate-sensitive exposures directly linked to asthma and airway diseases
- understanding and modeling the impact of climate change on air quality, aeroallergens, and aerosolized marine toxins, and the resulting effects on asthma and airway diseases including in vulnerable populations
- applying modeling originally developed to assess health effects of air pollution and other ecological niche modeling to climate-sensitive diseases
- establishing climate-sensitive exposure metrics, with appropriate temporal and spatial dimensions, that are most strongly associated with asthma, allergy, and airway diseases
- identifying and mapping populations and communities at increased risk of climate-related respiratory disease, which will also help to identify populations at risk for other climate-related health impacts as many environmentally mediated diseases share common risk factors
- using epidemiological investigations to study the relationship between climate variables; altered production, distribution, and reactivity of pollen and marine toxins; changes in air pollutants; and the prevalence, severity, and onset of asthma exacerbations
- studying the health effects of airborne and indoor dust on asthma exacerbation, including changes in dust composition resulting from climate change
- understanding the acute and long-term impacts of wildfires on asthma and other respiratory diseases
- examining chemicals used in energy efficient technologies to ensure that they do not contribute to lung sensitization, asthma, or other respiratory diseases
- examining the relative risks for respiratory disease based on chemicals with lower global warming potential than existing greenhouse gases
- developing early warning systems for state and local governments and public and environmental health officials to anticipate and mitigate climate-related health impacts
- improving methods of identifying risks and communicating with vulnerable populations to reduce climate change impacts on all respiratory diseases
- developing decision support tools including health impact assessments (HIAs) of the burden of respiratory diseases attributable to climate change for help in identifying and selecting climate change and air quality mitigation and adaptation policies that will promote health benefits

Research needs also call for improvements in various capacities and skills. Air pollution modeling is well established and the health impacts of several species of particles and aeroallergens are reasonably well understood. However, the complex introduction of aeroallergens under a changing climate will require the expansion of scientific expertise to include botany and ecology in addition to meteorology and the built environment. Research will require the use of geographic information systems (GIS) and remote sensing expertise in new ways, as well as the application of novel vulnerability mapping techniques, early warning systems, and other public health tools. Spatial epidemiological methods will bring new power to ecological studies of air quality and public health. Identification and collection of integrated and appropriately scaled social, ecological, and epidemiological data are needed for effective monitoring and modeling. For health communications, novel strategies are required to identify vulnerable populations and develop communication strategies that will effectively reduce risk.



2

Cancer

Cancer refers to a group of diseases in which abnormal cells divide without control and are able to invade other tissues. There are more than 100 different types of cancer, and they are generally referred to by the organ or type of cell in which they arise (e.g. breast, prostate, colon). Cancer is the second leading cause of death in the United States after heart disease, killing more than half a million people every year.⁵⁶ Lung cancers, with about 220,000 new cases per year and about 160,000 deaths,⁵⁷ account for about 30% of overall deaths from cancer in the United States.⁵⁸ The main cause of lung cancer is smoking, especially cigarettes, but air pollution,⁵⁹ including indoor air pollution⁶⁰ and fine particulates,⁶¹ also contributes to the burden of lung cancers.

There are potential impacts on cancer both directly from climate change and indirectly from climate change mitigation strategies. Climate change will result in higher ambient temperatures that may increase the transfer of volatile and semi-volatile compounds from water and wastewater into the atmosphere, and alter the distribution of contaminants to places more distant from the sources, changing subsequent human exposures.⁶² Climate change is also expected to increase heavy precipitation and flooding events, which may increase the chance of toxic contamination leaks from storage facilities or runoff into water from land containing toxic pollutants. Very little is known about how such transfers will affect people's exposure to these chemicals—some of which are known carcinogens—and its ultimate impact on incidence of cancer.⁶³ More research is needed to determine the likelihood of this type of contamination, the geographical areas and populations most likely to be impacted, and the health outcomes that could result.

Although the exact mechanisms of cancer in humans and animals are not completely understood for all cancers, factors in cancer

development include pathogens, environmental contaminants, age, and genetics. Given the challenges of understanding the causes of cancer, the links between climate change and cancer are a mixture of fact and supposition, and research is needed to fill in the gaps in what we know.

Impacts on Risks

One possible direct impact of climate change on cancer may be through increases in exposure to toxic chemicals that are known or suspected to cause cancer following heavy rainfall and by increased volatilization of chemicals under conditions of increased temperature. In the case of heavy rainfall or flooding, there may be an increase in leaching of toxic chemicals and heavy metals from storage sites and increased contamination of water with runoff containing persistent chemicals that are already in the environment. Marine animals, including mammals, also may suffer direct effects of cancer linked to sustained or chronic exposure to chemical contaminants in the marine environment, and thereby serve as indicators of similar risks to humans.⁶⁴ Climate impact studies on such model cancer populations may provide added dimensions to our understanding of the human impacts.

Another direct effect of climate change, depletion of stratospheric ozone, will result in increased ultraviolet (UV) radiation exposure. UV radiation exposure increases the risk of skin cancers and cataracts.⁶⁵ The incidence of typically nonlethal basal cell and squamous cell skin cancers is directly correlated to the amount of exposure to UV radiation. This effect is compounded by several other variables including temperature and exposure to other compounds that can amplify the carcinogenic potential of UV radiation.⁶⁶ Rising temperatures (such as occur at night versus day and in summer versus winter) are associated with increases in UV exposure. If increases in average or peak temperatures occur as a result of climate change, an increase in the incidence of non-melanoma skin cancers may occur.⁶⁷ Previous studies have shown that increased UV radiation exposure combined with certain polycyclic aromatic hydrocarbons (PAHs) can enhance

56 National Cancer Institute. What is cancer?, 2009 [cited 2009 July 21]; Available from: <http://www.cancer.gov/cancertopics/what-is-cancer>.

57 National Cancer Institute. Lung Cancer, 2009 [cited 2009 July 26]; Available from: <http://www.cancer.gov/cancertopics/types/lung>.

58 Centers for Disease Control and Prevention. Leading causes of death, 2006, 2009 [cited 2009 July 22]; Available from: <http://www.cdc.gov/nchs/FASTATS/lcod.htm>.

59 Beelen, R, et al., *Epidemiology*, 2008. 19(5): p. 702-10.

60 Ibid.

61 Krewski, D, et al., *Res Rep Health Eff Inst*, 2009(140): p. 5-114; discussion 115-36, Pope, CA, 3rd, et al., *JAMA*, 2002. 287(9): p. 1132-41.

62 Macdonald, RW, et al., *Human and Ecological Risk Assessment*, 2003. 9(3): p. 643-660.

63 Bates, B, et al., *Climate change and water*. 2008, Intergovernmental Panel on Climate Change: Geneva. p. 210.

64 McAloose, D, et al., *Nat Rev Cancer*, 2009. 9(7): p. 517-26.

65 Tucker, MA, *Hematol Oncol Clin North Am*, 2009. 23(3): p. 383-95, vii.

66 Burke, KE, et al., *Toxicol Ind Health*, 2009. 25(4-5): p. 219-24.

67 van der Leun, JC, et al., *Photochem Photobiol Sci*, 2008. 7(6): p. 730-3.

the phototoxicity of these compounds and damage DNA.⁶⁸ However, it is also possible that increased exposure to UV radiation could elevate levels of circulating Vitamin D, which has been associated with a decreased risk for certain cancers such as colorectal cancer.⁶⁹ Increased UV radiation also could impact the human immune system and alter the body's ability to remove the earliest mutant cells that begin the cancer process, although it is unclear whether these changes would be beneficial or detrimental.⁷⁰

Mitigation and Adaptation

In addition to direct impacts of climate change on cancer, the impact of mitigation strategies on cancer should also be considered. For instance, co-benefits of decreased greenhouse gas emissions and decreased cancer incidence may be attainable with energy efficient power generation and reduced emissions through lower vehicle miles traveled. These benefits could be realized through decreases in toxic outputs of fossil fuel-based power generation and transportation, including sulfur oxide and particulate matter (PM), which have been implicated in lung cancer.⁷¹

Decreases in greenhouse gas emissions are generally associated with decreases in cancers that occur due exposure to such pollutants. Increased energy efficiency will lead to reductions in emissions of sulfur dioxide, nitrous oxides, and PM, which should lead to reductions in rates of premature death including from certain cancers.⁷² In most cases, these emission reductions will also result in subsequent reductions in ambient concentrations of ozone and secondary PM_{2.5}, which have been implicated in a variety of health effects including lung cancer. Reductions in other hazardous air pollutants, such as heavy metals from power generation and industrial processes that are known or suspected to cause cancer or other serious health effects, may also occur.

Several technologies currently being pursued to decrease greenhouse gas emissions may also help to reduce cancer incidence. For example, reducing greenhouse gas emissions from the transportation sector may be accomplished by reducing vehicle miles traveled through a variety of approaches such as high-density development, preservation of green space, and widespread use of mass transit. However, the impacts of some mitigation technologies on cancer have not been fully explored.

For example, nanotechnology may be promising for mitigating climate change through its use in efficient hydrogen powered vehicles, enhanced and cheaper solar power technology, and the development of a new generation of batteries and supercapacitors, yet little is known about potential links to cancer and other health outcomes.

New technologies have been proposed to decrease our dependence on greenhouse gas-intensive power generation and fuel use. However, many of these have potential impacts on cancer that should be more fully investigated prior to being implemented. The widespread adoption of biofuels may have unintended consequences including possible increases or decreases in cancer due to a change in the level of existing pollutants or the creation and emissions of new air pollutants.⁷³ Also, barring changes in agricultural practices, there is potential for increased pesticide use for the growth of certain biofuels such as corn ethanol. Exposure to some legacy pesticides has been implicated for cancer in both adults and children,⁷⁴ leading to current efforts by the EPA to avoid this problem in new products.

Research is needed to understand if there are cancer implications from the use of electric vehicles, including the production and disposal of portable electric storage systems. Manufacturing of batteries for electric cars and photovoltaic (solar) power systems may have consequences including increased exposure to metals. The most common type of battery currently in use is the nickel-metal-hydride (NiMH) battery, with other types of batteries (lithium ion, lithium ion polymer, valve regulated lead acid, and nickel-cadmium) also under development for vehicle use. Increased use of NiMH batteries will necessarily require significant increases in nickel production and the impacts associated with nickel mining and refining. High-level nickel exposure is associated with increased cancer risk, respiratory disease, and birth defects; the same is true with certain other metals, especially cadmium and lead.

Increased production of solar cells also can lead to increased environmental risks.⁷⁵ For example, cadmium-tellurium (CdTe) compounds in photovoltaic systems and the potential for increased cadmium emissions from mining, refining, and the manufacture, utilization, and disposal of photovoltaic modules. Cadmium and cadmium compounds like CdTe are classified as known human carcinogens

68 Dong, S, et al., *Chem Res Toxicol*, 2000. 13(7): p. 585-93, Toyooka, T, et al., *Environ Mol Mutagen*, 2006. 47(1): p. 38-47.

69 Garland, CF, et al., *Ann Epidemiol*, 2009. 19(7): p. 468-83.

70 Sleijffers, A, et al., *J Immunotoxicol*, 2004. 1(1): p. 3-14.

71 Pope, CA, 3rd, et al., *JAMA*, 2002. 287(9): p. 1132-41.

72 Woodcock, J, et al., *Lancet*, 2009. 374(9705): p. 1930-43, Haines, A, et al., *Lancet*, 2009, Wilkinson, P, et al., *Lancet*, 2009. 374(9705): p. 1917-29.

73 Hill, J, et al., *Proceedings of the National Academy of Sciences of the United States of America*, 2009. 106(6): p. 2077-2082.

74 Flower, KB, et al., *Environ Health Perspect*, 2004. 112(5): p. 631-5, Kang, D, et al., *Environ Res*, 2008. 107(2): p. 271-6, Mahajan, R, et al., *Environ Health Perspect*, 2006. 114(12): p. 1838-42.

75 Pthenakis, V, in *Practical handbook of photovoltaics : fundamentals and applications*, T Markvart, et al., Editors. 2001: Elsevier Advanced Technology: New York, Pthenakis, VM, et al., *Environ Sci Technol*, 2008. 42(6): p. 2168-74.

by the National Toxicology Program and the International Agency for Research on Cancer and as probable human carcinogens by the EPA.⁷⁶ Acute exposure to CdTe can result in respiratory irritation and toxicity. Some of the other hazardous materials present in solar manufacturing include arsenic compounds, carbon tetrachloride, hydrogen fluoride, hydrogen sulfide, lead, and selenium compounds,⁷⁷ many of which have been linked with multiple health effects, including cancer.

Production of hydrogen fuel cells will require significant increases in the total amount of platinum consumed worldwide, with a similar increase in mining and the environmental impacts associated with mining, processing, and transport. If hydrogen is used in a significant way as a transportation fuel, consideration must be given to the impacts of emissions from leaks during production, fueling, and operation. Increased hydrogen leaks could result in stratospheric ozone depletion by up to 20%,⁷⁸ which could lead to increased incidence of skin cancer.

For mitigation of climate change, nuclear power has been suggested as a possible alternative to coal-based power generation. Although the risks associated with direct exposure to radiation from nuclear power generation have been below accepted danger levels throughout the industry's history, the human health consequences over the full nuclear energy life cycle (production through waste disposal) may be of greater concern.⁷⁹

Health Impact Assessments (HIAs) are a useful emerging strategy for evaluating the health effects of novel policies and technologies at various scales, and have already been applied to several potential climate change mitigation strategies.⁸⁰ Given the widespread uncertainty regarding the potential health impacts, including cancer, of certain mitigation strategies, HIAs can be a valuable tool for evaluating possible health effects, especially when used in combination with other approaches to life-cycle assessment.

Research Needs

Many of the cancer risks resulting from the direct effects of climate change have been fairly well studied. The largest research gaps are in the materials and methods used for mitigation and adaptation, and

their potential to increase or decrease cancer risks. Research needs include:

- utilizing animal cancer surveillance and investigations as sentinel biomedical models to better understand the environmental factors, mechanisms, and pathways of mammalian cancer risk
- developing and sustaining facilities and expertise to rapidly assess and monitor the threat of previously unrecognized toxins, carcinogens, and other bioactive molecules produced in response to stress on marine environments
- understanding the impact of increased heavy precipitation and flooding events on the risk of toxic contamination of the environment from storage facilities or runoff from land containing toxic chemicals, including the geographical areas, ecosystems, and populations most likely to be impacted and the health outcomes that could result
- understanding how climate changes such as changes in temperature and precipitation affect exposure to toxic chemicals including volatile and semi-volatile compounds and known or suspected human carcinogens
- elucidating the effects of ambient temperature on UV radiation-induced skin cancers, including the amplification of non-melanoma skin cancers
- evaluating the potential cancer risks through the entire life cycle of biofuel production, including risks from novel air pollutants and changes in agricultural practices that may increase exposures to pesticides, herbicides, and other environmental contaminants
- understanding cancer risks from the life cycle emissions of carcinogens and untested compounds associated with alternative energy and transportation technologies, particularly electricity storage systems and photovoltaic systems
- clarifying the life cycle cancer risks of nuclear energy radiation, including through occupational and environmental exposures
- developing mechanisms to conserve and explore marine and terrestrial biodiversity in environments likely to yield cancer cures and treatments
- characterizing and quantifying changes in cancer rates from implementation of specific greenhouse gas mitigation strategies, especially for existing fossil fuel-based energy production and use

76 Rep Carcinog, 2005(11): p. 1-A32.

77 Fthenakis, V. in Practical handbook of photovoltaics : fundamentals and applications, T Markvart, et al., Editors. 2003, Elsevier Advanced Technology: New York.

78 Tromp, TK, et al., Science, 2003. 300(5626): p. 1740-2.

79 Massachusetts Institute of Technology. 2003, [Boston MA]: MIT. x, 170 p.

80 Patz, J, et al., Health impact assessment of global climate change: Expanding on comparative risk assessment approaches for policy making, in Annual Review of Public Health. 2008. p. 27-39.



3

Cardiovascular Disease and Stroke

Cardiovascular disease refers to a class of diseases that pertain to the heart or blood vessels. Cardiovascular disease is the leading cause of death in the United States, with 631,636 deaths in 2006, the last year for which statistics are available. Stroke is the third leading cause, with 131,119 deaths in 2006.⁸¹ Approximately 80 million Americans have some form of cardiovascular disease including hypertension, coronary artery disease, heart attack, or stroke.⁸² Other cardiovascular diseases such as cardiac dysrhythmias (abnormal electrical activity in the heart), deep venous thrombosis (blood clots), and pulmonary embolism (blood clots in the lung) increase the numbers further. The American Heart Association and the National Heart, Lung, and Blood Institute together estimate that cardiovascular disease will be responsible for \$475.3 billion in direct and indirect health care expenditures in 2009.⁸³ Altogether, this diverse set of conditions is a major driver of health care expenditures and disability.

There is evidence of climate sensitivity for several cardiovascular diseases, with both extreme cold and extreme heat directly affecting the incidence of hospital admissions for chest pain, acute coronary syndrome, stroke, and variations in cardiac dysrhythmias, though the reported magnitude of the exposure-outcome associations is variable.⁸⁴ Weather conditions such as extreme heat serve as stressors in individuals with pre-existing cardiovascular disease, and can directly precipitate exacerbations.⁸⁵ There is also evidence that heat amplifies the adverse impacts of ozone and particulates on cardiovascular disease. These pollutants are likely to be affected by climate change mitigation activities, and thus, likely reduce rates of cardiovascular morbidity and mortality. While the fraction of disease risk attributable to weather and associated environmental exposures is not known, given the prevalence of cardiovascular disease and the preventable nature of the exposures, further research into associations between weather, climate variability, long-term climate change, and cardiovascular disease is an immediate need.

Impacts on Risk

Cardiovascular mortality associated with heat has been declining over time, presumably the result of increased air conditioning use; mortality associated with extreme cold has remained constant.⁸⁶ Cardiovascular hospital admissions increase with heat.^{87, 88} Dysrhythmias are primarily associated with extreme cold,⁸⁹ though associations with dysrhythmias and heat illness have been reported.⁹⁰ Stroke incidence increases with increasing temperature, as well.⁹¹ For all direct associations between temperature and cardiovascular disease and stroke, elderly and isolated individuals are at greatest risk.

Indirect impacts of weather, weather variability, and climate changes on cardiovascular disease are many and varied. Associations between air quality, especially ozone and particulate burdens, and cardiovascular disease appear to be modified by weather and climate. Ozone, whose formation increases with temperature, increases cardiac effort and impairs pulmonary gas exchange.⁹² Ozone concentrations modify the association between temperature and cardiovascular mortality,⁹³ and are also associated with acute myocardial infarction⁹⁴ (as discussed in the chapter on Asthma, Respiratory Allergies, and Airway Diseases). Particulate matter is associated with a variety of pathophysiological changes including systemic inflammation, deranged coagulation and thrombosis, blood vessel dysfunction and atherosclerotic disease, compromised heart function, deep venous thromboses,⁹⁵ and pulmonary embolism.⁹⁶ Increased burden of PM_{2.5} is associated with increased hospital admissions and mortality from cardiovascular disease,⁹⁷ as well as ischemic heart disease.⁹⁸

Other climate-related exposures are indirectly associated with incidence of cardiovascular disease and disease exacerbations.

81 Centers for Disease Control and Prevention. Leading causes of death, 2006. 2009 [cited 2009 July 22]; Available from: <http://www.cdc.gov/nchs/FASTATS/lcod.htm>.
82 American Heart Association. Cardiovascular disease statistics, 2006. 2009 [cited 2009 July 22]; Available from: <http://www.americanheart.org/presenter.jhtml?identifier=4478>.
83 American Heart Association. Cardiovascular disease cost, 2009. 2009 [cited 2009 July 22]; Available from: <http://www.americanheart.org/presenter.jhtml?identifier=4475>.
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88 Schwartz, J, et al., Epidemiology, 2004. 15(6): p. 755-761.
89 Kysely, J, et al., BMC Public Health, 2009 Jan 15;9:19..
90 al-Harthi, SS, et al., Int J Cardiol, 1992. 37(2): p. 151-4.
91 Ebi, KL, et al., Int J Biometeorol, 2004. 49(1): p. 48-58.
92 Gong, H, et al., American Journal of Respiratory and Critical Care Medicine, 1998. 158(2): p. 538-546.
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97 Jerrett, M, et al., New England Journal of Medicine, 2009. 360(11): p. 1085-1095.
98 Pope, CA, et al., Journal of the Air & Waste Management Association, 2006. 56(6): p. 709-742.

Extreme weather events affect cardiovascular health through several pathways. Directly, the stress of the event and anxiety over event recurrence are associated with myocardial infarction,⁹⁹ sudden cardiac death,¹⁰⁰ and development of stress-related cardiomyopathy.¹⁰¹ Indirectly, displacement related to disasters is frequently associated with interruptions of medical care for chronic medical conditions,¹⁰² putting populations with chronic cardiovascular conditions at risk for disease exacerbations.

Climate is also implicated in another indirect risk for cardiovascular disease: the incidence of certain vectorborne and zoonotic diseases (VBZD) with cardiovascular manifestations. One estimate holds that approximately 10% of strokes in the developing world are related to exposure to certain VBZD,¹⁰³ many of which are climate sensitive. In particular, Chagas disease is an important cause of stroke worldwide (although not in the United States); 20 million people globally have chronic Chagas, which is an independent risk factor for stroke in Latin America¹⁰⁴ and a leading cause of heart failure in South America.¹⁰⁵ There is some evidence of climate sensitivity for Chagas disease,¹⁰⁶ though the topic is little studied. In the United States, Lyme disease is a prevalent vectorborne disease that has cardiovascular manifestations,¹⁰⁷ though the incidence of such manifestations is much lower than that associated with Chagas disease.

There is little published literature on the projected direct and indirect impacts of climate change on cardiovascular disease incidence. Many of the studies coupling down-scaled climate projections with health outcomes have examined a particular exposure, such as heat or ozone, and projected mortality based on known associations, but do not make specific projections as to the incidence of cardiovascular morbidity and mortality. Insofar as climate change will bring increased ambient temperatures, increasingly variable weather, and increased extreme events, we can infer that climate change will likely have an overall adverse impact on the incidence of cardiovascular disease. Similarly, the impact of climate change on the incidence of cardiovascular complications from extreme weather events and certain VBZD is also likely to increase. However, the magnitude of these effects and the degree to which they can be lessened with adaptation efforts is unclear and warrants much further study.

Mitigation and Adaptation

The likely impacts of climate change mitigation activities on risk of cardiovascular disease and stroke depend primarily on emissions-associated energy production activities, particularly in the transportation sector. Some mitigation activities related to energy production, such as the increased use of wind, wave, solar, and nuclear sources of power generation, are likely to reduce cardiovascular disease risks by reducing particulate and other air pollution emissions.

Mitigation activities such as increasing the density of urban development, enhancing public transportation options, and encouraging alternatives to single occupancy vehicle use are likely to benefit cardiovascular fitness, reducing the overall burden of cardiovascular disease.¹⁰⁸ More research is needed, including economic analyses, to determine the most beneficial strategies to pursue. As with reparatory health risks, risks of cardiovascular disease and stroke may be reduced in urban populations through filtration of ambient pollutants by tree cover.¹⁰⁹ Co-benefits of tree cover include heat-island alleviation, reduced energy use to cool buildings, and consequent reductions in greenhouse gas emissions.¹¹⁰

Fuel mixtures each have different particulate and other criteria pollutant profiles, and variously reduce net greenhouse gas emissions.¹¹¹ Fuel mixtures associated with high emissions of particulates or other pollutants such as nitrous oxides and carbon monoxide will have adverse impacts on cardiovascular health,¹¹² as these pollutants are associated with incidence of cardiovascular hospital admissions among those with existing heart disease.¹¹³ Preliminary analysis of certain biodiesel blends is promising¹¹⁴ but more research is needed to fully characterize likely health impacts of large-scale mitigation activities related to transport fuels.¹¹⁵ Some biodiesel blends appear to produce emissions with few negative health consequences.¹¹⁶

While an association between PM exposure and increased risk of cardiovascular disease has been demonstrated, it is unclear which chemical constituents mediate this effect. More research is needed to better identify these pollutants, which in turn will help to predict the potential benefits of alternative combustible fuels.¹¹⁷ Due to

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- 108 Frumkin, H, et al., *American Journal of Public Health*, 2008. 98(3): p. 435-445.
 109 Bowker, G, et al., *Atmospheric Environment*, 2007. 41: p. 8128-8139, Nowak, D, et al., *Urban Forestry and Urban Greening*, 2006. 4: p. 115-123.
 110 Bolund, P, et al., *Ecological Economics*, 1999. 29: p. 293-301, McPherson, E, et al., *Urban Ecosystems*, 1997. 1: p. 49-61.
 111 Hill, J, et al., *Proc Natl Acad Sci U S A*, 2006. 103(30): p. 11206-10.
 112 Hill, J, et al., *Proceedings of the National Academy of Sciences of the United States of America*, 2009. 106(6): p. 2077-2082.
 113 Mann, JK, et al., *Environmental Health Perspectives*, 2002. 110(12): p. 1247-1252.
 114 McCormick, RL, *Inhalation Toxicology*, 2007. 19(12): p. 1033-1039.
 115 Swanson, KJ, et al., *Environmental Health Perspectives*, 2007. 115(4): p. 496-499.
 116 McCormick, RL, *Inhalation Toxicology*, 2007. 19(12): p. 1033-1039.
 117 Brook, RD, et al., *Circulation*, 2004. 109(21): p. 2655-71.

99 Suzuki, S, et al., *American Heart Journal*, 1997. 134(5): p. 974-977.

100 Leor, J, et al., *New England Journal of Medicine*, 1996. 334(7): p. 413-419.

101 Watanabe, H, et al., *Journal of the American Medical Association*, 2005. 294(3): p. 305-307.

102 Krousel-Wood, MA, et al., *American Journal of the Medical Sciences*, 2008. 336(2): p. 99-104.

103 Carod-Artal, FJ, *Revista De Neurologia*, 2007. 44(12): p. 755-763.

104 Ibid.

105 Bocchi, EA, et al., *Heart*, 2009. 95(3): p. 181-189.

106 Carcavallo, RU, *Memorias Do Instituto Oswaldo Cruz*, 1999. 94: p. 367-369.

107 Cox, J, et al., *American Heart Journal*, 1991. 122(5): p. 1449-1455.

the unique electrophysiological properties associated with the very high heart rates of the rodents most commonly used in researching dysrhythmia, these biomedical models do not always closely replicate human conditions. In contrast, the rates and underlying physiology of fish hearts are closer to humans and, as such, fish models should be explored as tools for understanding and screening the effects of various transport fuels.¹¹⁸

Projecting the health impacts of adaptation activities, particularly the increased use of air conditioning to protect vulnerable populations from extreme heat, requires assumptions regarding how these activities will be powered. For instance, if significant additional electricity demand is met through increased fossil fuel combustion, then there is likely to be increased exposure to particulates and ozone as a result. However, these exposures may be partially offset by the protective effect of air conditioning. Most other adaptation activities are likely to have little direct impact on cardiovascular disease incidence.

Research Needs

As noted, there are significant gaps in our understanding of climate change impacts on cardiovascular disease, particularly for morbidity, and there is virtually no research projecting future cardiovascular health impacts of climate change. Research needs include:

- increasing research on the incidence of cardiac dysrhythmias and associations with temperature and other environmental exposures
- enhancing research on the complex synergistic effect of temperature, weather variability, long-term climate change, and environmental exposures such as criteria air pollutants on the incidence of various cardiovascular disease outcomes
- intensifying investigation of the likely cardiovascular complications of VBZD prevalent in the United States and globally
- characterizing the multiple individual constituents of air pollution to better anticipate the health effects from switching the mix of pollutants in air through the use of alternative fuels
- studying strategies for incorporating cardiovascular disease outcomes in HIAs and integrated assessment climate models, including further characterization of exposure-outcome associations for cardiovascular morbidity in different geographic regions

- developing a national standard for heat-related mortality to facilitate epidemiologic study of mortality from heat and other co-morbid conditions¹¹⁹
- targeting research on early warning systems and health communications aimed at groups particularly at risk for adverse cardiovascular outcomes related to climate change
- identifying and quantifying the co-benefits to cardiovascular health of reducing our reliance on fossil fuel-based energy and changing emission scenarios
- characterizing both the potential health risks and benefits of novel fuels and other energy production activities being considered for large-scale adoption as part of a national mitigation strategy

Several cardiovascular disease research priorities dovetail with other areas. In particular, research into health impacts of increased temperature, extreme weather, and changes in air quality associated with climate change will inform research into cardiovascular health impacts. Similarly, research into early warning systems and integrated assessment models is transferable to other health outcomes associated with climate change, and research into the health impacts of potential mitigation and adaptation activities can be applied to other health outcomes sensitive to particulate and other emissions.

118 Milan, DJ, et al., *Ibid.* 2009. 120(7): p. 553-9.

119 Wainwright, S, et al., *American Journal of Epidemiology*, 1994. 139(11): p. 549-549.



4

Foodborne Diseases and Nutrition

Nutrition is the sum of the processes by which humans and other living organisms take in food and use it for growth and nourishment. Along with clean air, water, and shelter, nutritious food is a basic necessity of life. Failure to obtain sufficient calories and an adequate mixture of macronutrients (calories, fat, proteins, carbohydrates), micronutrients (vitamins, minerals) and other bioactive components of food can result in illness and death. According to the United Nations Development Program, some 3.7 billion people worldwide are currently malnourished. While malnutrition and hunger are predominantly problems in the developing world, the United States and other developed countries still have significant populations affected by insufficient food resources and undernutrition.¹²⁰ Extreme weather events and changes in temperature and precipitation patterns can directly damage or destroy crops and other food supplies, as well as interrupt transport and distribution of food. This may happen seasonally, but is anticipated to become a more chronic problem under changing climate conditions. Indirectly, there is potential for harm from undernutrition or even famine resulting from damage to agricultural crops and related trade, economic, and social instability; diversion of staple crops for use in biofuels (corn for ethanol or other biofuels); changes in agricultural practices including those intended to mitigate or adapt to climate change; impaired ability to grow crops due to changing environmental conditions and water availability; and reduced availability and nutritional quality of protein from fisheries, aquaculture, and other marine-based foods.

In addition to being a source of essential nutrients, food can be a source of exposure for foodborne illness. Such illness results from ingesting food that is spoiled or contaminated with microbes, chemical residues such as pesticides, biotoxins, or other toxic substances. It is estimated that there are 38 million cases of foodborne illness in the United States each year, resulting in over 180,000 hospitalizations and 2,700 deaths.¹²¹ Seafood contaminated with metals, biotoxins, toxicants, or pathogens; crops burdened with chemical pesticide residues or microbes; extreme shortages of staple foods; and malnutrition are among the possible effects of climate change on the production, quality, and availability of food.¹²² The potential effects of climate change on foodborne illness, nutrition, and security are for the most part indirect

RESEARCH HIGHLIGHT

Climate change may impact rates of foodborne illness through increased temperatures, which are associated with increased incidence of foodborne gastroenteritis. Several species of *Vibrio*, naturally occurring marine bacteria, are sensitive to changes in ocean temperature. *Vibrio parahaemolyticus* infects oysters and is the leading cause of *Vibrio*-associated gastroenteritis in the United States.¹



An outbreak in 2004 in Alaska has been linked to higher than normal ocean temperatures.² Other studies show a predictive relationship between sea surface temperature and *V. vulnificus* and *V. cholera*. Climate-driven changes in ocean temperature and coastal water quality are expected to increase the geographic range of these bacteria, and could be used to predict outbreaks. Increased temperatures also affect rates of other foodborne illnesses including campylobacteriosis and salmonellosis. A recent article examined the relationship between temperature and the weekly rates of several foodborne illnesses in England and Wales, including food poisoning, campylobacteriosis, and salmonellosis infections, and demonstrated this relationship. Research shows a significant correlation of these illnesses with ambient temperature at the time of illness and with the previous week's temperature.³ Depending on the type of foodborne illness, for every degree centigrade rise in temperature, results showed 2.5–6% relative increase in the risk of foodborne illness. In the United States, good statistics on foodborne diseases are lacking, although estimates range from 6 million to 81 million illnesses and up to 9,000 deaths each year. Though current surveillance of foodborne illness in the United States is patchy and the burden of severe disease is not well known, further research may make it possible to translate these numbers into health impacts.

120 Nord, M, et al., Household food security in the United States, 2008, ER Service, Editor. November, 2009, US Department of Agriculture: Washington, DC.

121 Mead, PS, et al., Emerg Infect Dis, 1999. 5(5): p. 607-25.

122 Intergovernmental Panel on Climate Change. Working Group II. 2007, Cambridge: Cambridge University Press. ix, 976 p.

1 US Food and Drug Administration, Quantitative risk assessment on the public health impact of pathogenic *Vibrio parahaemolyticus* in raw oysters. 2005.

2 McLaughlin, JB, et al., N Engl J Med, 2005. 353(14): p. 1463-70.

3 Lake, IR, et al., Epidemiol Infect, 2009. 137, p. 1538–1547.

and, in the United States at least, may be moderate and unlikely except in the event of disruption of government regulatory programs. However, on a global scale they are huge in terms of numbers of people likely to be affected and consequent human suffering. The Intergovernmental Panel on Climate Change projected with high confidence an increase in malnutrition and consequent disorders, including those related to child growth and development, as a result of climate change.¹²³ Some of these effects are already being felt in the wake of extreme weather events such as droughts, flooding, and hurricanes, and as such present a fairly immediate concern. The World Health Organization estimated that in 2000, there were over 77,000 deaths from malnutrition and 47,000 deaths from diarrhea (many from foodborne exposures) due to climate change.¹²⁴

Impacts on Risks

The U.S. Climate Change Science Program (CCSP) reported a likely increase in the spread of several foodborne pathogens due to climate change, depending on the pathogens' survival, persistence, habitat range, and transmission in a changing environment.¹²⁵ Drought has been shown to encourage crop pests such as aphids, locusts, and whiteflies, as well as the spread of the mold *Aspergillus flavus* that produces aflatoxin, a substance that may contribute to the development of liver cancer in people who eat contaminated corn and nuts. Agronomists are also concerned that climate change-based increases in a variety of blights, rusts, blights, and rots will further devastate already stressed crops, and thereby exacerbate malnutrition, poverty, and the need for human migration. The spread of agricultural pests and weeds may lead to the need for greater use of some toxic chemical herbicides, fungicides, and insecticides,¹²⁶ resulting in potential immediate hazards to farm workers and their families,¹²⁷ as well as longer-term hazards to consumers, particularly children.¹²⁸

The safety of agricultural crops and fisheries also may be threatened through contamination with metals, chemicals, and other toxicants that may be released into the environment as a result of extreme weather events, particularly flooding, drought, and wildfires, due to climate change.¹²⁹ Global changes in ocean currents and water mass distribution, along with changes in Arctic ice cover, length of melt

season, hydrology, and precipitation patterns, will alter contaminant and pathogen pathways.¹³⁰ Contaminants include a wide range of chemicals and metals such as PCBs, PAHs, mercury, and cadmium; pharmaceuticals such as synthetic hormones, statins, and antibiotics; widely used industrial chemicals such as fire retardants, stain repellants, and non-stick coatings; and pesticides and herbicides for agricultural use and vector control for public health protection. The health effects of human exposure to these environmental agents via complex land and ocean food webs are not well documented or understood, but evidence from animal studies is showing that such compounds accumulate in foods at concentrations that may affect fetal development, immune function, and other biological processes. These agents often occur together and may act synergistically, producing potentially greater harm than a single agent.

Recent findings demonstrate that pathogens that can pose disease risks to humans occur widely in marine organisms and may be affected by climate change.¹³¹ In one specific example, the CCSP noted the strong association between sea surface temperature and proliferation of many *Vibrio* bacteria species that occur naturally in the environment (including those that cause cholera), and suggested that rising temperatures would likely lead to increased occurrence of illness associated with *Vibrio* bacteria in the United States, especially seafood-borne disease associated with *V. vulnificus* and *V. parahaemolyticus*.¹³² Rising temperatures and impacts on other environmental parameters such as ocean acidification may also lead to more virulent strains of existing pathogens and changes in their distribution, or the emergence of new pathogens.¹³³ Increased risks from animal-borne disease pathogens could be especially acute in human populations that are highly dependant on marine-based diets for subsistence and who live where environmental effects resulting from climate change are pronounced (for example in certain native populations in Alaska).¹³⁴ Increased acidity of water associated with climate change may alter environmental conditions leading to greater proliferation of microbes of a public health concern. This is a significant concern in molluscan shellfish, because ocean acidification may affect formation of their carbonate shells and immune responses, making them more vulnerable to microbial infection. The combined impact of potential contaminant-induced immune suppression and expanding ranges of disease-causing pathogens and biotoxins on food supply could be significant.

123 Ibid.

124 Campbell-Lendrum, D, et al. Environmental Burden of Disease Series, ed. A Pruss-Ustun, et al. 2007. Geneva: World Health Organization. 66.

125 Gamble, JL, et al. 2008. Washington, D.C.: U.S. Climate Change Science Program. ix, 204 p.

126 Gregory, PJ, et al., J Exp Bot. 2009. 60(10): p. 2827-38.

127 Lynch, SM, et al., Environ Res. 2009. 109(7): p. 860-8; Park, SK, et al., Int J Occup Environ Health. 2009. 15(3): p. 274-81; Rusiecki, JA, et al., Environ Health Perspect. 2009. 117(4): p. 581-6.

128 Eskenazi, B, et al., Basic Clin Pharmacol Toxicol. 2008. 102(2): p. 228-36; Rosas, LG, et al., Curr Opin Pediatr. 2008. 20(2): p. 191-7.

129 Ebi, K, et al. in Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, J Gamble, et al., Editors. 2008, USEPA: Washington, D. C.

130 Ibid.

131 Moore, SK, et al., Environmental Health: A Global Access Science Source. 2008. 7(SUPPL. 2).

132 Ebi, K, et al. in Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, J Gamble, et al., Editors. 2008, USEPA: Washington, D. C.

133 Smolinski, MS, et al. 2003, Washington, D.C.: National Academies Press. xxviii, 367 p.

134 Sokurenko, EV, et al., Nat Rev Microbiol. 2006. 4(7): p. 548-55.

Mitigation and Adaptation

In the long term, mitigation and adaptation decisions affecting food and nutrition including, for example, the diversion of staple crops for biofuel feedstock, the increased need for agricultural chemicals due to climate-related increases in pests and changes in pest habitats, and planning needs for the maintenance of food supply infrastructure and transport in the wake of extreme weather events are important factors to be considered in a strategic research plan for climate change and health. The benefits of biofuels, genetically modified organisms, new pesticides, and alternative energy on nutrition and foodborne illness must also be considered. All of these technologies have great potential to help humans mitigate and adapt to climate change, and each should be carefully evaluated to ensure that the best are implemented.

Health implications, both positive and negative, of changes in animal agriculture and aquaculture as a result of climate change mitigation and adaptation need to be identified and quantified. For example, climate change events such as drought and flooding can result in changes in animal feed quality and the use of marginal lands for animal grazing affects water and habitat quality. Better understanding is needed of effects of the use of new or increased herbicides and pesticides in response to changes in growing conditions caused by climate change, as well as potential health effects for both humans and animals of ingestion of crops that have been genetically modified to withstand stress conditions caused by climate change. The health implications of biomass-based energy and biofuels, including interactions between climate mitigation strategies affecting agricultural and energy policies and availability of food, must be a priority area of research.

Research Needs

New efforts are needed to combine current and anticipated advances in detection and warning systems for food, nutrition, and foodborne health threats with epidemiologic studies on the occurrence and severity of poor nutrition and foodborne disease in humans. This is especially needed for high-risk populations such as women, infants, and children, and people in resource-constrained settings. Research needs include:

- projecting impacts of climate change including increases in CO₂, temperature, drought, floods, and other extreme weather events, and changes in growing seasons on food production, availability, contamination, and nutritional value

- understanding and predicting potential ecosystem changes from climate change that may establish new foodborne pathogens, chemical contaminants, or biotoxins, as well as new pathways for human exposure
- assessing the impacts of climate change on outbreak incidence, geographic range, and growth cycles of insect pests and pathogens that can infect food crops and seafood, and cause human disease
- understanding the effects of changes in food safety due to climate change-related alterations in the accumulation and toxicity of foodborne contaminants, biotoxins, and pathogens
- understanding of changes in nutritional status associated with climate change that may increase individual susceptibility to the adverse health impacts of other environmental exposures such as chemicals and heavy metals
- improving surveillance of disease-causing agents (chemical contaminants, pathogens, toxins) in food animals, agricultural crops, and seafood, as well as monitoring of exposed human populations in order to improve estimates of disease related to contamination of the food supply
- identifying and characterizing aspects of food production and distribution systems that will reduce risk of contamination and disease and ensure sustainability under climate change scenarios
- understanding the effect of ocean acidification from climate change-related increases in air pollution on seafood quality and availability
- developing and implementing models linking climate change and other environmental data (such as land use, land cover, hydrology) to crops and seafood to improve prediction and risk assessment
- developing and implementing early warning systems to manage agriculture and fisheries risks related to climate change, including improved communications with domestic and international food security agencies



EMERGENCY

Heat-Related Morbidity and Mortality

As a result of anthropogenic climate change, global mean temperatures are rising, and are expected to continue to increase regardless of progress in reducing greenhouse emissions.¹³⁵ Global average temperatures are projected to increase between 1.8 and 4.0°C by end of this century.¹³⁶ Climate change is expected to raise overall temperature distribution and contribute to an increase in the frequency of extreme heat events, or heat waves.¹³⁷ Temperature, particularly temperature extremes, is associated with a wide range of health impacts.

The health outcomes of prolonged heat exposure include heat exhaustion, heat cramps, heat stroke, and death.¹³⁸ Extreme heat events cause more deaths annually in the United States than all other extreme weather events combined.¹³⁹ In the United States, an average of 688 persons succumb to heat-related death per year.¹⁴⁰ Prolonged exposure to heat may also result in additional illness and death by exacerbating preexisting chronic conditions such as various respiratory, cerebral, and cardiovascular diseases,¹⁴¹ as well as increasing risk for patients taking psychotropic drug treatment for mental disorders,¹⁴² due to the body's impaired ability to regulate temperature. Figures for these illnesses and deaths may be dramatically underestimated as disparities in health care make morbidity measurements difficult and heat is rarely identified as an official cause of death. Some public health response organizations are in the process of developing heat early warning systems for anticipated heat wave events and extended warm periods.

Varying age groups have been shown to be sensitive to all-cause mortality under excessive heat stress, including adults over 65, children, and infants under 1 year of age.¹⁴³ For type-specific mortality, sensitivity to death from respiratory disease has been demonstrated in the general population and in the elderly.¹⁴⁴ In

general, risk of respiratory death due to heat stress is greater than that of cardiovascular effects. Sensitivity to cerebrovascular disease-related death has been reported in Europe.¹⁴⁵ More commonly, sensitivity to cardiovascular disease-related mortality associated with heat has been seen in the whole population, as well as among the elderly. Elevated hyperthermia death risk also has been seen among the elderly in the United States.¹⁴⁶ However, heat-related risks are not regionally or locally uniform; demographic shifts in the United States will produce concentrations of larger populations with higher mean age, and thereby, heightened vulnerability to excessive heat.¹⁴⁷

Impacts on Risk

Both increased average temperatures and increasingly frequent and severe extreme heat events produce increased risks of heat-related illness and death that can be significant: the European heat wave of 2003 caused more than 35,000 excess deaths.¹⁴⁸ Human susceptibility to heat-related illness depends on several different factors, from physiologic adaptation to the local environment to socioeconomic status, and the impact of these changing exposures will depend on the vulnerability of exposed populations. As noted above, host factors such as age and the burden of other serious illnesses such as heart disease and diabetes that might exacerbate heat-related problems are important. In the United States, the number of individuals 65 years of age and older (who are more susceptible to heat effects) is expected to increase from 12.4% in 2000 to 20% in 2060.¹⁴⁹ Socioeconomic factors also determine vulnerability; economically disadvantaged and socially isolated people face higher burdens of death from heat.¹⁵⁰

Cities and climate are co-evolving in a manner that will certainly amplify both the health effects of heat and the vulnerability of urban populations to heat-related deaths by magnifying the increased temperatures caused by climate change as compared to adjacent rural and suburban locales.^{151,152} The urban built environment can

135 Houghton, JT, et al. 2001. Cambridge ; New York: Cambridge University Press. x, 881 p.

136 Intergovernmental Panel on Climate Change. Working Group II. 2007. Cambridge: Cambridge University Press. ix, 976 p.

137 Meehl, GA, et al., Science, 2004. 305(5686): p. 994-7.

138 Ellis, FP, Trans R Soc Trop Med Hyg, 1976. 70(5-6): p. 402-11.; Kilbourne, EM, et al., JAMA, 1982. 247(24): p. 3332-6.

139 Luber, G, et al., Am J Prev Med, 2008. 35(5): p. 429-35.

140 Merchandani, H, et al., Journal of the American Medical Association, 1993. 270(7): p. 810-810.

141 Kovats, RS, et al., Heat stress and public health: A critical review, in Annual Review of Public Health. 2008. p. 41-55.

142 Davido, A, et al., Emerg Med J, 2006. 23(7): p. 515-8.

143 Bytowski, JR, et al., Curr Sports Med Rep, 2003. 2(6): p. 320-4; Piver, WT, et al., Environ Health Perspect, 1999. 107(11): p. 911-6; Ye, F, et al., Environ Health Perspect, 2001. 109(4): p. 355-9; Curriero, FC, et al., Am J Epidemiol, 2002. 155(1): p. 80-7; Davis, RE, et al., Environmental Health Perspectives, 2003. 111(14): p. 1712-1718; Gosling, SN, et al., Climatic Change, 2009. 92(3-4): p. 299-341.

144 Kovats, RS, et al., Heat stress and public health: A critical review, in Annual Review of Public Health. 2008. p. 41-55.

145 Gosling, SN, et al., Climatic Change, 2009. 92(3-4): p. 299-341.

146 Curriero, FC, et al., Am J Epidemiol, 2002. 155(1): p. 80-7.

147 Luber, G, et al., Am J Prev Med, 2008. 35(5): p. 429-35.

148 Vandentorren, S, et al., Am J Public Health, 2004. 94(9): p. 1518-20.

149 Wilmoth, JM, et al., Research on Aging, 2006. 28(3): p. 269-288.

150 Gosling, SN, et al., Climatic Change, 2009. 92(3-4): p. 299-341.

151 Brazel, AJ, et al., in Encyclopedia of world climatology, JE Oliver, Editor. 2005, Springer: Dordrecht, The Netherlands: XX, 854 p.

152 Patz, JA, et al., Nature, 2005. 438(7066): p. 310-7.

both exacerbate and alleviate the effects of heat. For example, high concentrations of buildings in urban areas cause what is known as the urban heat island effect: generating as well as absorbing and releasing heat, resulting in urban centers that are several degrees warmer than surrounding areas. Expanding parks and green spaces and increasing the density of trees in and around cities can help to reduce this effect.¹⁵³ It is estimated that 60% of the global population will live in cities by 2030, greatly increasing the total human population exposed to extreme heat.¹⁵⁴

Researchers comparing annual heat-related deaths for the city of Los Angeles in the 1990s to those projected for the mid- and late-21st century have concluded that heat-related deaths will increase, perhaps up to seven-fold.¹⁵⁵ Another study assessing 21 U.S. cities estimates that for most of the cities, summer deaths will increase dramatically and winter deaths will decrease slightly, even with acclimatization. This shift to higher summer heat-related deaths will likely outweigh the extra winter deaths averted.¹⁵⁶ Climate change is projected to increase the average number of summer-time heat-related deaths, with the greatest increases occurring in mid-latitude major cities where summer climate variability is greatest. Noting that the number of current heat-related deaths in U.S. cities is considerable in spite of mortality displacement (reduced mortality in the months following a heat event due to increased early deaths of critically ill people who would have died in the near-term regardless) and the increased use of air conditioning, a substantial rise in weather-related deaths is the most likely direct health outcome of climate change.¹⁵⁷

It is difficult to make valid projections of heat-related illness and death under varying climate change scenarios. A review of past changes in heat-related deaths found few significant relationships for any decade or demographic group, and suggested that improved medical care, air conditioning use, and other adaptation efforts were the causes of reduced death, stating that despite increasing stressful weather events, heat-related deaths are preventable, as evidenced by the decline of all-cause mortality during heat events over the past 35 years.¹⁵⁸ Overall, research suggests that under a climate change scenario using current anthropogenic emissions

trends, there will be a small increase in the overall U.S. heat-related death rate by the end of the 21st century.¹⁵⁹ A standardized definition and methodology for identifying heat-related health outcomes is needed for surveillance and to evaluate temperature-related illness and death.

Mitigation and Adaptation

While climate change is likely to increase the burden of heat-related illness and death in the United States, many of these outcomes are preventable. With aggressive public health actions and widespread physiologic and behavioral adaptations such as robust heat early warning systems and other health communications, increased air conditioning use, decreased time spent outdoors, and increased wearing of sun-shielding clothing it will be possible to reduce overall rates of illness and death, though some of these measures may result in negative health consequences as well.¹⁶⁰

Adaptation occurs through a range of physiological, behavioral, and technological mechanisms, and the slight reduction in heat-related deaths in the United States, despite warming trends, is likely a result of adaptation. In a report on acclimatization in elderly people over time, researchers showed both a declining risk of heat-related cardiovascular deaths until no excess risk remained and a steady risk of cold-related deaths.¹⁶¹ This effect was observed in other populations as well: over four 10-year time periods in the 20th century in London, progressive reductions in temperature-related deaths (both cold and hot) were reported, despite an aging population.¹⁶² Cities with cooler climates tend to experience more heat-related deaths than those with warmer climates because populations can acclimatize to some extent to heat and because populations in warmer climates are more likely to have access to air conditioning. Heat-related death rates declined significantly over four decades (the period of 1964–1998) in 19 of 28 U.S. metropolitan areas¹⁶³ although the trend seems to have leveled off since the 1990s.¹⁶⁴

Although air conditioning may explain the reduced heat-related death risk, it also may be due to improved standards of living, better access to medical care, biophysical coping mechanisms, and infrastructural adaptations. Depending on methods of power generation and the air conditioning technology used, however,

153 Bolund, P, et al., *Ecological Economics*, 1999. 29: p. 293-301, McPherson, E, et al., *Urban Ecosystems*, 1997. 1: p. 49-61.

154 United Nations Department of Economic and Social Affairs Population Division *World Urbanization Prospects: The 2005 Revision*, PD United Nations Department of Economic and Social Affairs, Editor. 2006, United Nations Department of Economic and Social Affairs, Population Division: Geneva.

155 Hayhoe, K, et al., *Proc Natl Acad Sci U S A*, 2004. 101(34): p. 12422-7.

156 McMichael, AJ, et al., *Lancet*, 2006. 367(9513): p. 859-869.

157 Kalkstein, LS, et al., *Environ Health Perspect*, 1997. 105(1): p. 84-93.

158 Davis, RE, et al., *Climate Research*, 2002. 22(2): p. 175-184.

159 Deschenes, O, et al., *Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US*, in *Center for the Study of Energy Markets Paper*. 2007, Center for the Study of Energy Markets: Santa Barbara, CA. p. 61.

160 McGeehin, MA, et al., *Environ Health Perspect*, 2001. 109 Suppl 2: p. 185-9.

161 Barnett, AG, *Epidemiology*, 2007. 18(3): p. 369-72.

162 Carson, C, et al., *Am J Epidemiol*, 2006. 164(1): p. 77-84.

163 Davis, RE, et al., *Environmental Health Perspectives*, 2003. 111(14): p. 1712-1718.

164 Sheridan, SC, et al., *Natural Hazards*, 2009. 50(1): p. 145-160.

increased use of air conditioning may result in higher greenhouse gas emissions.¹⁶⁵ In addition, to the extent that power grids become overburdened during excessive heat events, resulting blackouts and brownouts could leave populations at increased risk of deaths.

From a public health perspective, proactive heat wave response plans may prove to be a more sustainable adaptation strategy. Following a 2003 heat wave in Western Europe, France established a National Heat Plan incorporating several preventive measures aimed at reducing the risks related to high temperatures including a heat early warning system. During a lasting and severe heat wave in 2006, the excess death rate in France was much lower than expected given the high numbers of deaths three years earlier; research suggests that the decrease may have resulted from implementation of this plan.¹⁶⁶

Research Needs

Research needs to improve understanding of heat-related illness and death, as well as impacts of heat mitigation and adaptation, include:

- developing and implementing a standard definition of heat-related health outcomes, as well as standard methodologies for surveillance of outcomes and evaluation of adaptations
- understanding risk factors for illness and death associated with both acute exposure to extreme heat events and long-term, chronic exposure to increased average temperatures, including how such exposure may alter human physiology (for example, by impacting the body's ability to metabolize and excrete harmful environmental toxicants)
- identifying which temperature-related metrics are most strongly related to increased hospitalization and mortality during heat waves
- quantifying the combined effects of exposure to heat waves and ambient air pollution on excessive illness and death
- conducting comparative analyses of heat-related death risks for application to national scale analyses
- determining attributes of communities, including regional and seasonal differences, that are more resilient or vulnerable to adverse health impacts from heat waves
- assessing the health benefits of the use of environmental design principles to reduce the high thermal mass of urban areas
- characterizing the likelihood and nature of multi-system failures, such as power grid failure, that could lead to significant morbidity and mortality during a heat wave
- enhancing the ability of current climate models to capture the observed frequency and intensity of heat waves across various timescales to support weather-climate predictions and use of heat early warning systems in decision making
- evaluating heat response plans, focusing on environmental risk factors, identification of high-risk populations, effective communications strategies, and rigorous methods for evaluating effectiveness on the local level

¹⁶⁵ Yoshida, Y, Carbon Balance Manag, 2006. 1: p. 12.

¹⁶⁶ Fouillet, A, et al., Int J Epidemiol, 2008. 37(2): p. 309-17.



6

Human Developmental Effects

Most humans develop in a predictable fashion, growing from a fertilized egg to fetus, newborn, toddler, child, adolescent, and adult in a way that is fairly well understood. The environment can be a potent modifier of normal development and behavior. Environmental effects on development include subtle changes such as small reductions in IQ from exposure to lead,¹⁶⁷ changes in onset of puberty from exposure to endocrine disrupting chemicals,¹⁶⁸ birth defects such as cleft palate due to dioxin-like compounds,¹⁶⁹ and fetal loss through exposure-related spontaneous abortion.¹⁷⁰ According to the Centers for Disease Control and Prevention, about 3% of all children born in the United States have a birth defect, some of which can be attributed to environmental causes. Birth defects are a leading cause of death in children, accounting for almost 20% of all infant deaths. Babies born with birth defects also have a greater chance of illness and long-term disability than children without birth defects.¹⁷¹ Some of these birth defects have been steadily increasing over the last 20 years, for example the rates of congenital heart defects have doubled,¹⁷² suggesting a possible environmental linkage, although other explanations such as better reporting may also explain the rise.

Recent research into early functional programming has opened a new perspective on the developmental and early life origins of human disease.¹⁷³ Vulnerable periods during human development include preconception (gametogenesis), preimplantation, the fetal period, and early childhood. Environmental exposures during these periods can lead to functional deficits and developmental changes through several mechanisms including genetic mutations and epigenetic change. Some chemicals damage DNA directly, causing mutations in gametes or the developing fetus that can lead to later disease or conditions that increase disease risks such as obesity.¹⁷⁴ For example, toxins such as domoic acid, a biotoxin released from harmful algal blooms and taken up by seafood and

RESEARCH HIGHLIGHT

Many of the chemicals that we use to control pests and improve crop yields can impact human development. Climate change will alter rainfall and temperature in various parts of the planet. In some cases, climate change will lead to changes in agricultural practices for crop yields that might increase pesticide use and thereby increase human exposures. Changes in the range of mosquitoes and other pests that can carry disease also may lead to an increase in the use of legacy pesticides (e.g. DDT). Malaria is rare in the United States, although the number of cases (imported or indigenous) have been increasing over the last decade in some locations.¹ The insecticide DDT is highly efficient for the control of mosquitoes that are capable of transmitting malaria to humans. Although withdrawn from use in the United States, DDT is still used as a desperate expedient to control mosquitoes in malaria-endemic areas around the world. DDT and its principal metabolite, DDE, are persistent in the environment and in humans. Research has shown that women whose mothers had high DDT levels in their blood when they were *in utero* have shortened menstrual cycles and a reduced chance of getting pregnant. A landmark study showed that for every 10 milligrams per liter of DDT in mother's serum, the probability of pregnancy for the daughter dropped by 32%.² Other pesticides also have been linked to similar decreases in fertility.³ Later studies on similar exposures showed equivocal results on time-to-pregnancy, but suggested effects on fetal loss, child growth, and male reproductive development.⁴



167 Stein, J, et al., J Dev Behav Pediatr, 2002. 23(1 Suppl): p. S13-22.

168 Rogan, WJ, et al., Int J Hyg Environ Health, 2007. 210(5): p. 659-67.

169 Pradat, P, et al., Birth Defects Res A Clin Mol Teratol, 2003. 67(12): p. 968-70.

170 Bukowski, JA, Regul Toxicol Pharmacol, 2001. 33(2): p. 147-56.

171 CDC. Birth Defects, 2009 [cited 2009 July 22]; Available from: <http://www.cdc.gov/ncbddd/bd/>.

172 Correa-Villaseñor A, et al., Birth Defects Res A Clin Mol Teratol, 2003. 67(9): p. 617-24.

173 Aagaard-Tillery, KM, et al., Journal of Molecular Endocrinology, 2008. 41(2): p. 91-102.

174 Wadhwa, PD, et al., Semin Reprod Med, 2009. 27(5): p. 358-68.

1 WHO. Global Malaria Programme. 2008, Geneva: World Health Organization. xx, 190 p.

2 Cohn, BA, et al., Lancet, 2003. 361(9376): p. 2205-6.

3 Roelleveld, N, et al., Curr Opin Obstet Gynecol, 2008. 20(3): p. 229-33.

4 Longnecker, MP, et al., Am J Epidemiol, 2002. 155(4): p. 313-22, Law, DC, et al., Am J Epidemiol, 2005. 162(6): p. 523-32, Longnecker, MP, et al., Environ Res, 2005. 97(2): p. 127-33, Ribas-Fito, N, et al., Int J Epidemiol, 2006. 35(4): p. 853-8.

marine mammals, can bioaccumulate in amniotic fluid and alter fetal development.¹⁷⁵ Chemicals can also cause epigenetic changes that alter the way DNA is interpreted, leading to inheritable functional changes without changing DNA itself. These epigenetic changes could have consequences for many diseases and developmental changes.¹⁷⁶ For example, maternal undernutrition may act on the developing fetus to program the risks for adverse health outcomes such as cardiovascular disease, obesity, and metabolic syndrome in adult life. In this way, changes in maternal nutrition and *in utero* exposure to certain chemicals or biotoxins due to climate change may impact the health of future generations through epigenetic changes before conception and during pregnancy. Developmental changes can result in a lifetime of suffering and have significant societal costs in terms of resources, medical care, and lost productivity.¹⁷⁷

Impacts on Risk

People at different stages of life can respond very differently to environmental changes. Some changes to the environment resulting from climate change could alter normal human development both in the womb and later in life. Foodborne illness and food insecurity, both likely outcomes of climate change [see chapter on Nutrition and Foodborne Diseases], may lead to malnutrition. While adult humans exposed to mild famine usually recover quite well when food again becomes plentiful, nutritional reductions to a fetus in the womb appear to have lasting effects throughout life.¹⁷⁸ Malnutrition and undernutrition in pregnant women are a global cause of low birth weight and other poor birth outcomes that are associated with later developmental deficits. Malnutrition is predominantly a problem in the developing world, but in the United States, one in six children still live in poverty,¹⁷⁹ and other developed countries also have substantial populations with insufficient food resources and undernutrition¹⁸⁰ that could be made worse by climate change. Climate change effects on food availability and nutritional content could have a marked, multigenerational effect on human development.¹⁸¹

Changes in patterns and concentrations of contaminants entering the marine environment due to climate change will impact seafood species, many of which provide a major source of protein to global populations. Such contaminants, particularly metals such as mercury and lead that accumulate in fish and seafood, are a special

concern for human developmental effects.¹⁸² Similarly, an increase in the use of herbicides and pesticides for agricultural purposes, as well as alterations in environmental degradation of such chemicals due to changes in climate, could result in increased exposures that would exceed safety guidelines and increase the risk of developmental changes.¹⁸³

Other environmental exposures to pregnant women and to children that are associated with climate change also present hazards to normal human development. For example, certain commercial chemicals present in storage sites or hazardous waste sites can alter human development. Flooding from extreme weather events and sea-level rise are likely to result in the release of some of these chemicals and heavy metals, most likely affecting drinking and recreational waters. Some of these, including mercury and lead, have known negative developmental effects.

And while more research is required, there is good reason for concern based on our current body of knowledge of certain toxic metals and persistent organic compounds. Of the metals likely to become more prevalent in human environments due to climate change, inorganic arsenic is of great concern because it is a potent human carcinogen, it alters the immune system, and it is a general poison that is lethal at certain doses. More than 100 million people worldwide are exposed to arsenic through groundwater contamination and industrial emissions. Both inorganic and methylated forms of arsenic have been shown to impede fetal development and increase spontaneous abortions.¹⁸⁴ Persistent organic compounds, even those no longer in use in many locales such as DDT and PCBs, could increase in some human environments and decrease in others as a result of flooding and extreme weather events due to climate change.¹⁸⁵ Many of the Superfund toxic waste sites in the United States contain PCBs and dioxins that have been linked to cognitive deficits in children that continue throughout their lives. It is expected that every person on the planet carries some body burden of PCBs, but people living near contaminated sites have greater exposures and an increased risk of disease.¹⁸⁶ Dioxins, PCBs, asbestos, benzene, flame retardants, certain pesticides, and other chemicals are known to be immunotoxicants. Changes to the immune system during development can remain throughout life, possibly resulting in a reduced capacity to fight serious infection and an increased risk of several other diseases including cancer.

175 Maucher, JM, et al., *Environmental Health Perspectives*, 2007. 115(12): p. 1743-1746.

176 Mathers, JC, *Nutrigenomics - Opportunities in Asia*, 2007. 60: p. 42-48.

177 CDC. Birth Defects, 2009 [cited 2009 July 22]; Available from: <http://www.cdc.gov/ncbddd/bd/>.

178 Mathers, JC, *Nutrigenomics - Opportunities in Asia*, 2007. 60: p. 42-48.

179 Nord, M, et al., *Household food security in the United States*, 2008, ER Service, Editor. November, 2009, US Department of Agriculture: Washington, DC.

180 Nord, M, et al., *Household food security in the United States*, 2008, ER Service, Editor. November, 2009, US Department of Agriculture: Washington, DC.

181 Noyes, PD, et al., *Environment International*, 2009. 35(6): p. 971-986.

182 Booth, S, et al., *Environ Health Perspect*, 2005. 113(5): p. 521-6.

183 Macdonald, RW, et al., *Human and Ecological Risk Assessment*, 2003. 9(3): p. 643-660.

184 Tofail, F, et al., *Environmental Health Perspectives*, 2009. 117(2): p. 288-293.

185 Macdonald, RW, et al., *Human and Ecological Risk Assessment*, 2003. 9(3): p. 643-660, Macdonald, RW, et al., *Sci Total Environ*, 2005. 342(1-3): p. 5-86.

186 Franzblau, A, et al., *Chemosphere*, 2009. 74(3): p. 395-403.

Climate change may alter the abundance and distribution of harmful algal blooms and their associated biotoxin accumulation in fish and seafood.¹⁸⁷ Currently there are over 100 known biotoxins associated with harmful algal blooms, and the biological effects of most are currently unknown; however, some have been shown to cross the placenta and affect the developing fetus.¹⁸⁸ It is partly for this reason though that fish species provide excellent biomedical models for developmental toxicity research, particularly the study of congenital heart defects. Such defects are notoriously difficult to study in standard rodent models due to the early dependency of mammalian embryos on circulatory function to provide oxygen. Because fish embryos are not dependent on early circulation for oxygen, fish models have made highly significant contributions to cardiac developmental studies in the past decade.¹⁸⁹

Mitigation and Adaptation

In regions where water availability is a growing concern, there will be an increasing need to reuse water or seek alternate sources of water that may be of lower quality. This may result in new treatment options that may require the use of additional or more toxic chemicals.

Changes in energy source policies also could increase exposures to numerous airborne metal particulates, many of which, such as lead, have known adverse developmental impacts.¹⁹⁰ Given the large number of chemicals that are currently in commerce, the unknown degree to which climate change will alter human exposure to these compounds, and the lack of data on the developmental toxicity of most of these compounds, this is an area strongly in need of additional research.

Access to prenatal health care and to early intervention services is critical in preventing and mitigating birth defects and impacts on human development. Following extreme weather events, such health care and services potentially may be disrupted for extended periods of time, increasing the risk of adverse long-term consequences for mothers, children, and society.

Research Needs

Research is needed to evaluate climate-related impacts at different life stages including direct and epigenetic effects (through exposures to mothers and fathers) that may be hazardous to human development. Such research could improve understanding of the long-term effects on human development and provide guidance on how mitigation and adaptation can reduce this health burden. Research needs include:

- understanding the effects of climate change-induced stress on human reproduction and development, including chronic and acute heat stress, and traumatic stress as a result of extreme weather events
- understanding how malnutrition may alter human development, how climate change may exacerbate such alterations, and how to develop effective strategies to minimize these impacts in vulnerable populations
- understanding the impacts of changes in weather patterns and ecosystems on the incidence, exposure, and distribution of chemical contaminants and biotoxins known to cause developmental disorders
- expanding the use of marine species as biomedical models and sentinels for understanding effects of contaminants and biotoxins on human reproduction and development
- understanding the implications of mitigation strategies, including changes in energy policies and new technologies, on the production, use, and storage of heavy metals and chemicals that are known to cause developmental disorders
- understanding how weather events affect access to health care and the implications of this for normal human development

187 Niemi, G, et al., *Environmental Health Perspectives*, 2004. 112(9): p. 979-986.

188 Ibid.

189 Chico, TJ, et al., *Trends Cardiovasc Med*, 2008. 18(4): p. 150-5.

190 Gohlke, JM, et al., *Environmental Health Perspectives*, 2008. 116(6): p. A236-A237.



Mental Health and Stress-Related Disorders

Mental health disorders comprise a broad class of illnesses from mild disorders, such as social phobias and fear of speaking in public, to severe diseases including depression and suicidal ideation. Many mental health disorders can also lead to other chronic diseases and even death. Stress-related disorders derive from abnormal responses to acute or prolonged anxiety, and include diseases such as obsessive-compulsive disorder and post-traumatic stress disorder. It is estimated that 26.2% of Americans over the age of 18 suffer from a diagnosable mental health disorder in a given year; 9.5% suffer from mood disorders, and 6% suffer from serious mental illness.¹⁹¹ However, mental health is an area of public health that is often a low research priority and one whose impacts on human and societal well being are typically underestimated, both within the United States and globally. It also is an area of public health in which disparities exist among socioeconomic groups in both access to and quality of care and treatment.¹⁹²

Psychological impacts of climate change, ranging from mild stress responses to chronic stress or other mental health disorders, are generally indirect and have only recently been considered among the collection of health impacts of climate change.¹⁹³ Mental health concerns are among some of the most potentially devastating effects in terms of human suffering, and among the most difficult to quantify and address. A variety of psychological impacts can be associated with extreme weather and other climate related events. There has been significant research conducted depicting ways in which extreme weather events can lead to mental health disorders associated with loss, social disruption, and displacement, as well as cumulative effects from repeated exposure to natural disasters.¹⁹⁴ The effects of climate change impact the social, economic, and environmental determinants of mental health, with the most severe consequences being felt by communities who were already disadvantaged prior to the event.¹⁹⁵ Extreme weather events such as hurricanes, wildfires, and flooding, can create increased anxiety and emotional stress about the future,¹⁹⁶ as well as create added stress to vulnerable communities already experiencing

social, economic, and environmental disruption. Individuals already vulnerable to mental health disease and stress-related disorders are likely to be at increased risk of exacerbated effects following extreme weather or other climate change events. Prolonged heat and cold events can create chronic stress situations that may initiate or exacerbate health problems in populations already suffering from mental disease and stress-related disorders. In addition, psychotropic drugs interfere with the body's ability to regulate temperature; individuals being treated with these drugs could be at increased risk of heat-related illness during extreme heat events.¹⁹⁷

The severity of mental health impacts following an extreme climate event will depend on the degree to which there is sufficient coping and support capacity, both during and following the event.¹⁹⁸ During the recovery period following an extreme event, mental health problems and stress-related disorders can arise from geographic displacement, damage or loss of property, death or injury of loved ones, and the stress involved with recovery efforts.¹⁹⁹ The most common mental health conditions associated with extreme events range from acute traumatic stress to more chronic stress-related conditions such as post-traumatic stress disorder, complicated grief, depression, anxiety disorders, somatic complaints, poor concentration, sleep difficulties, sexual dysfunction, social avoidance, irritability, and drug or alcohol abuse.²⁰⁰ The chronic stress-related conditions and disorders resulting from severe weather or other climate change-related events may lead to additional negative health effects. Studies have shown a negative relationship between stress and blood glucose levels, including influence on glycemic control among patients with type 2 diabetes.²⁰¹ Evidence has also shown that human response to repeated episodes of acute psychological stress or to chronic psychological stress may result in cardiovascular disease.²⁰² Although a direct cause and effect relationship has not yet been proven, some research has indicated a link between various psychological factors and an increased risk of developing

191 Kessler, RC, et al., *Arch Gen Psychiatry*, 2005. 62(6): p. 617-27.

192 Ibid.

193 Fritze, JG, et al., *Int J Ment Health Syst*, 2008. 2(1): p. 13.

194 Ibid.

195 Ibid.

196 Ibid.

197 Martin-Latry, K, et al., *Eur Psychiatry*, 2007. 22(6): p. 335-8.

198 Tapsell, SM, et al., *Philos Transact A Math Phys Eng Sci*, 2002. 360(1796): p. 1511-25.

199 Ebi, K, et al. in *Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research*, J Gamble, et al., Editors. 2008, USEPA: Washington, D. C.

200 Silove, D, et al., *J Postgrad Med*, 2006. 52(2): p. 121-5; Weisler, RH, et al., *JAMA*, 2006. 296(5): p. 585-8.

201 Surwit, RS, et al., *Diabetes Care*, 2002. 25(1): p. 30-4.

202 Black, PH, et al., *J Psychosom Res*, 2002. 52(1): p. 1-23.

some forms of cancer, as well as the progression of cancer in those already presenting with the disease.²⁰³

Climate change has the potential to create sustained natural and humanitarian disasters beyond the scale of those we are experiencing today, which may exceed the capacity of our public health systems to cope with societal demands.²⁰⁴ In the United States, this was demonstrated in 2005 by the devastating impact of Hurricane Katrina. Globally, climate change will continue to act as a threat to natural resources and ecosystem services that are already stressed, which may force the migration of large communities and create conditions leading to hostile political environments, conflict, and war.²⁰⁵ The resources required to meet the psychological needs of those affected by extreme weather events, environmental conflicts, or other effects of climate change may be limited immediately following such an event,²⁰⁶ or as people migrate in search of more stable natural environments.

Research on mental health service delivery following disaster events has only recently become a higher profile topic of scientific interest. Though some mental health diseases and stress-related disorders have been incorporated into the collection of health impacts of extreme weather and temperature events, numerous research gaps remain. More work is necessary to understand the effects of climate change and extreme weather events on mental health status, to determine how to mitigate these effects, and to overcome the barriers to utilization and delivery of mental health services following extreme weather events.

Impacts on Risks

The number of people killed by climatic, hydrological, and meteorological disasters in 2008 was the highest of the last decade, with 147,722 deaths reported worldwide.²⁰⁷ In the United States, Hurricanes Katrina and Rita, which hit the Gulf Coast in 2005, were two of the most damaging hurricanes recorded in U.S. history, impacting more than 90,000 square miles and directly affecting more than 1.5 million people, including forcing 800,000 citizens to be relocated from their homes.²⁰⁸ Scientific evidence supports that global warming will be accompanied by changes in the intensity, duration, and geographical extent of weather and climate extreme events; therefore, the threat to human health and well being from

events such as hurricanes, wildfires, flooding, and tornadoes is likely to continue, and perhaps worsen.²⁰⁹

It is also highly likely that the long-term effects of climate change will displace significant numbers of people, many of whom are already vulnerable members of society. Extreme weather events, sea-level rise, destruction of local economies, resource scarcity, and associated conflict due to climate change are predicted to displace millions of people worldwide over the coming century.²¹⁰ The most commonly cited figure of projected population displacement from climate change is 200 million people worldwide by 2050.²¹¹ Those with lower socio-economic standing are more likely to choose to relocate permanently following a devastating event, often due to limited resources to rebuild property and restore livelihood.²¹² In addition, people will continue to experience place-based distress caused by the effects of climate change due to involuntary migration or the loss of connection to one's home environment, a phenomenon called "Solastalgia."²¹³

The mental health impacts of environmentally displaced populations in conflict stricken areas have been well documented;²¹⁴ however, additional research is needed to better understand mental health impacts on such people as they relate to climate change and climate change-related migration. While there will likely be some displacement of populations in the United States caused by the effects of climate change, this issue is anticipated to have far greater consequences on a global scale. The results of climate science research on sea-level rise, extreme events such as flooding and droughts, the impacts of climate change on natural resources, and other impacts caused by climate variability and change must be connected to social science research. This link to social sciences, including behavioral science research, will help to build an understanding of when, how, and where population shifts may occur, thereby increasing the likelihood that necessary mental health services and support can be made available where and when they are needed most.

203 Antoni, MH, et al., *Nat Rev Cancer*, 2006. 6(3): p. 240-8.

204 The CNA Corporation, 2007: p. 68.

205 Kessler, RC, et al., *Arch Gen Psychiatry*, 2005. 62(6): p. 617-27.

206 Tapsell, SM, et al., *Philos Transact A Math Phys Eng Sci*, 2002. 360(1796): p. 1511-25.

207 International Federation of Red Cross and Red Crescent Societies, *World Disaster Report 2009*, in *World Disaster Report*, L Knight, Editor. 2009, International Federation of Red Cross and Red Crescent Societies: Geneva. p. 210.

208 Department of Homeland Security. *The First Year After Hurricane Katrina: What the Federal Government Did.*, 2009 [cited 2009 July 22]; Available from: www.dhs.gov/xfoia/archives/gc_1157649340100.shtm.

209 CCSP, *Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research.*, T Karl, et al., Editors. 2008, Department of Commerce, NOAA's National Climatic Data Center: Washington, DC, USA. p. 164.

210 Fritze, JG, et al., *Int J Ment Health Syst*, 2008. 2(1): p. 13.

211 Myers, N, *Philos Trans R Soc Lond B Biol Sci*, 2002. 357(1420): p. 609-13.

212 Hunter, LM, *Population and Environment*, 2005. 26(4): p. 273-302.

213 Albrecht, G, et al., *Australasian Psychiatry*, 2007. 15: p. S95-S98.

214 Crowley, C, *J Am Acad Nurse Pract*, 2009. 21(6): p. 322-31, Mills, E, et al., *Med Confl Surviv*, 2008. 24(1): p. 5-15, Naeem, F, et al., *J Ayub Med Coll Abbottabad*, 2005. 17(2): p. 23-5, Hollifield, M, et al., *Jama*, 2002. 288(5): p. 611-21.

Mitigation and Adaptation

There is a need to fully understand what gaps currently exist in mental health infrastructure, resources, and services; how these gaps may be exacerbated due to climate change; and the resulting impacts on mental health status, both in the United States and worldwide. This information can then be incorporated into mitigation and adaptation strategies. The information can also be used to ensure adequate resources are allocated to enable services to prepare for and deal with the impending challenges associated with climate change including both extreme and chronic weather events and sea-level rise. In addition, much work needs to be done to help individuals better self-identify their mental health needs and to increase their awareness of the existence of mental health services in their communities. Work also needs to be done to eradicate the stigma associated with the need for mental health care so that individuals will seek out mental health services following extreme weather or other climate-related events.

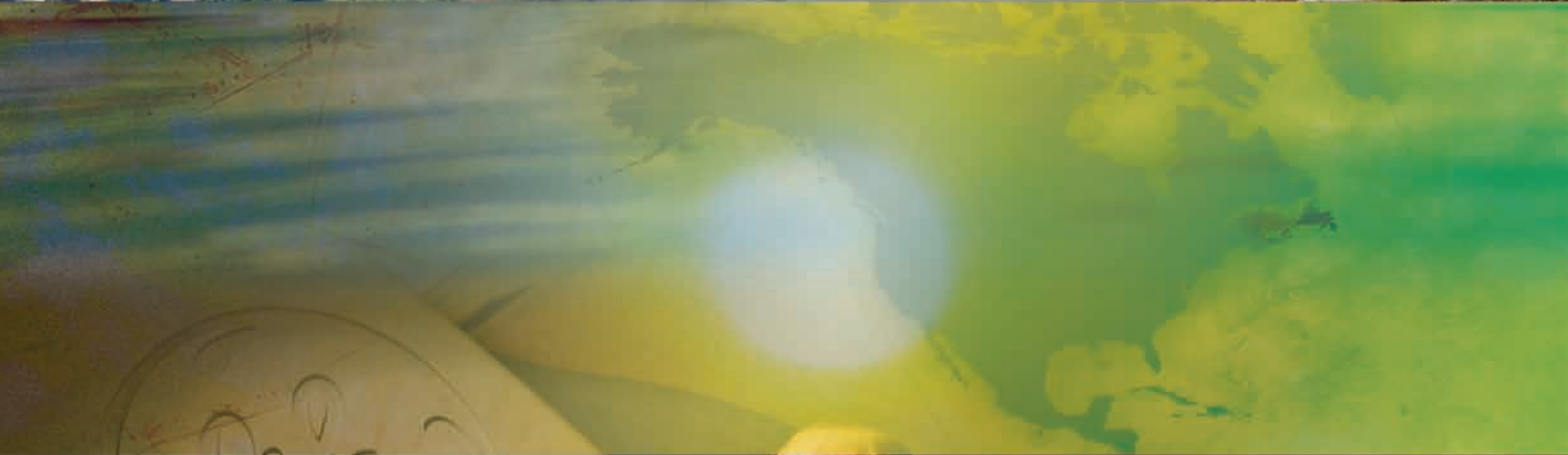
While some climate change adaptation measures may prevent the need for displacement and migration of communities, socioeconomically disadvantaged communities both within the United States and globally may not be able to effectively implement such adaptation measures. The effect may be social instability of the surrounding community, which will create additional stress and exacerbate the threat to overall mental health and well being.

Research Needs

Immediate research needs on the mental health implications of climate change²¹⁵ include:

- improving methods of identifying vulnerable mental health populations, and understanding the implications for these populations at the local and regional level
- identifying the most beneficial means of encouraging utilization of mental health services and delivering such services following extreme weather or other climate change events
- developing mental health promotion and communication programs related to proposed climate change mitigation and adaptation strategies
- understanding of how psychological stress acts synergistically with other forms of environmental exposures to cause adverse mental health effects
- understanding the critical social and economic determinants for mental health and overall community well-being that might be altered by climate change
- identifying and incorporating key mental health outcomes in health impact assessments, both for U.S. populations and worldwide, under a range of climate change scenarios
- developing and implementing monitoring networks to help track the migration of environmentally displaced populations to assist with the provision of mental health care and services

215 Fritze, JG, et al., Int J Ment Health Syst, 2008. 2(1): p. 13.



8

Neurological Diseases and Disorders

The United States has seen an increasing trend in the prevalence of neurological diseases and deficits.²¹⁶ Onset of diseases such as Alzheimer Disease (AD) and Parkinson Disease (PD) is occurring at earlier ages across the population. Environmental factors are suspected of playing a large role in both the onset and severity of these conditions, although there is a gap in our understanding of this role, especially in relation to genetics, aging, and other factors.²¹⁷ While some of these changes in neurological health likely are due to the aging of a large portion of the population, learning disabilities that affect children also are on the rise, and there are indicators that environmental factors may be involved including changes in climate that may exacerbate factors affecting the rates and severity of neurological conditions.^{218,219} Neurological conditions generally carry high costs in terms of quality of life for both the sufferer and the caregiver and increased healthcare stresses on the economy and the workforce. The combination of these factors could affect a sizable portion of the U.S. population, and have significant impacts on productivity.

Factors affected by climate with particular implications for neurological functioning include malnutrition;²²⁰ exposure to hazardous chemicals, biotoxins, and metals in air, food, and water;²²¹ and changes in pest management.²²² Understanding the role of climate in the incidence and progression of neurological conditions and how to prevent them is a critical need for public health and health care in the United States. Studies such as the National Children's Study²²³ are an excellent opportunity to improve our understanding in this area.

Impacts on Risk

Numerous recent reports have described observed and anticipated detrimental effects of climate change on ocean health, resulting in increased risks to neurological health from ingestion of or

RESEARCH HIGHLIGHT

Harmful algal blooms (HABs) are increasing worldwide and global climate change is thought to play a significant role. Many HAB-related biotoxins cause significant neurotoxic effects in both animals and humans including permanent neurological impairment. The algae *Pseudo-nitzschia* spp. produce domoic acid, a potent neurotoxin that causes

amnesiac shellfish poisoning in people. Blooms of this algae have been increasing off the California coast resulting in significant illness and death in marine animals. A decade of monitoring of health of California sea lions, a sentinel species for human health effects, indicates changes in the neurologic symptomatology and epidemiology of domoic acid toxicosis. Three separate clinical syndromes are now present in exposed animals: acute domoic acid toxicosis with seizure, permanent hippocampal atrophy, and death; a second novel neurological syndrome characterized by epilepsy associated with the chronic consequences of sub-lethal exposure to domoic acid; and a third syndrome associated with *in utero* exposures resulting in premature parturition, neonatal death, and significant neurotoxicity in the developing fetus resulting in seizure activity as the animal grows, as well as long-lasting impacts on memory and learning.¹ These observations indicate significant potential implications for human health effects, although their exact nature is not known and needs further study.



216 Steenland, K, et al., Alzheimer Dis Assoc Disord, 2009. 23(2): p. 165-70.

217 Bronstein, J, et al., Environmental Health Perspectives, 2009. 117(1): p. 117-121, Hendrie, HC, et al., Canadian Journal of Psychiatry-Revue Canadienne De Psychiatrie, 2004. 49(2): p. 92-99, Mayeux, R, Annals of Neurology, 2004. 55(2): p. 156-158.

218 Bronstein, J, et al., Environmental Health Perspectives, 2009. 117(1): p. 117-121, Mayeux, R, Annals of Neurology, 2004. 55(2): p. 156-158, Jones, L, et al., Lancet, 2009. 374(9690): p. 654-61.

219 Altevogt, BM, et al., Pediatrics, 2008. 121(6): p. 1225-1229.

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exposure to neurotoxins in seafood and fresh and marine waters.²²⁴ Neurotoxins produced by harmful algal blooms and other marine microorganisms can cause serious illness and death in humans. Under the correct conditions, harmful algal blooms produce potent neurotoxins that are often taken up and bioaccumulated in filter-feeding molluscan shellfish including oysters, clams, and mussels, as well as by certain marine and freshwater fish.²²⁵ The most frequent human exposures are via consumption of seafood containing algal toxins, although some toxins may be present in freshwater sources of drinking water, and others may be aerosolized by surf breaking on beaches and then transported by winds to where they can cause respiratory distress in susceptible individuals who breathe them.²²⁶ Because cooking or other means of food preparation do not kill seafood biotoxins, it is essential to identify contaminated seafood before it reaches consumers. Health effects including amnesia, diarrhea, numbness, liver damage, skin and eye irritation, respiratory paralysis, and PD- and AD-like symptoms may be severe, chronic, and even lead to death.²²⁷ It has recently been reported that even a single low-level exposure to algal toxins can result in physiological changes indicative of neurodegeneration.²²⁸ Work done on biotoxin-related neurologic disease in marine mammals indicates that domoic acid exposure can cause acute neurologic symptoms by crossing the placenta and accumulating in the amniotic fluid where it can impact neural development in the fetus, alter postnatal development, and lead to chronic illnesses such as epilepsy.^{229,230,231} Climate change may alter the geographic range in which harmful algal bloom toxins appear, the frequency of toxin production, and the actual delivery of toxins (both increasing and decreasing in some cases) due to extreme weather.²³² Harmful algal blooms are increasing in frequency, intensity, and duration globally, partially as a result of climate change, although this link is poorly understood.²³³ Nonetheless, it is clear that changes in precipitation and ocean temperatures, coupled with increased nutrient loading, may lead to earlier seasonal occurrence, as well as longer lasting and possibly more toxic harmful algal blooms.²³⁴

Emerging research suggests that exposure to a number of agents whose environmental presence may increase with climate change may have effects on neurological development and functioning. For example, exposure to pesticides and herbicides during specific developmental windows, in combination with other exposures later in life, could increase the risk of PD and other neurological diseases.²³⁵ Exposure to heavy metals is known to exacerbate neurological deficits and learning disabilities in children,²³⁶ and is suspected of being associated with both onset and exacerbation of AD²³⁷ and PD. Evidence suggests that early-life occurrence of inflammation in the brain, as a consequence of either brain injury or exposure to infectious agents, also may play a role in the pathogenesis of PD.²³⁸ In addition to conditions such as PD and AD, post-traumatic stress disorder (PTSD) is likely to have profound effects on the neurological functioning of populations exposed to the stress of extreme weather events, and the resulting dislocation and deprivation that may result from climate change.²³⁹

Mitigation and Adaptation

Mitigation to climate change may reduce our reliance on fossil fuels. This reduction in fossil fuel use will reduce the release of a number of neurotoxicants including arsenic, mercury, and other metals into the environment.²⁴⁰ Simple actions that reduce the amount of energy needed, such as expanded use of compact fluorescent light bulbs, will reduce the amount of toxic metals emitted into the air by coal-fired power plants. However, additional mercury releases into the environment might occur due to breakage of these fluorescent bulbs or improper disposal, resulting in human exposures and potential neurological effects.²⁴¹ In more complicated mitigation strategies such as the expansion of the use of electric vehicles, heavy metals used in the batteries for such vehicles may present manufacturing and disposal challenges that will be of particular significance to the risk of neurological deficits.²⁴²

Adaptation efforts such as the increased use of pesticides to improve crop yield in areas with reduced farming capabilities may result in runoff of potentially neurotoxic pesticides into reservoirs and coasts used to capture water for human use, thereby increasing

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241 Noyes, PD, et al., Environment International, 2009. 35(6): p. 971-986.

242 Bronstein, J, et al., Environmental Health Perspectives, 2009. 117(1): p. 117-121.

human exposures.²⁴³ Alternately, recent research has shown multiple benefits on mental and neurological functioning as a result of increased exposure to natural and green space settings, particularly in urban areas.²⁴⁴ Adaptation strategies that encourage and allow walkable cities and exercise, increases in green space and urban forestry, and improved green building methods that reduce the potential for exposure to chemicals such as arsenic and lead that leach from building materials could all contribute to reductions in neurological deficits. Numerous other mitigation and adaptation strategies may have both positive and negative health effects, most of which are poorly recognized or understood. Thus, any proposed mitigation and adaptation strategies will need to be carefully evaluated for both benefits and potential neurological effects.

Research Needs

More research is needed regarding the link between environmental exposures, the onset and severity of neurological diseases and disorders, and the relationship to climate change. Research needs include:

- identifying the factors that initiate harmful algal blooms and bacterial proliferations, focusing on the effects of temperature changes, shifts in rainfall patterns, and other climate-associated factors on their distribution, occurrence, and severity
- improving understanding of the mechanisms and pathways of acute and chronic exposures to harmful algal biotoxins and their impacts on fetal, postnatal, and adult development
- utilizing marine animal models to better understand the mechanisms and outcomes of exposure to harmful algal biotoxins individually and in conjunction with chemical exposures
- developing and validating strategies to inhibit the formation and severity of harmful algal blooms
- expanding research on the toxicity of chemicals known or suspected to cause neurological disorders, particularly pesticides, and on understanding how climate change may affect human exposure to such chemicals
- improving our understanding of the impact of increased heavy precipitation, ice melts, and flooding events on the risk of toxic contamination of the environment from storage-related issues or runoff, focusing on the likelihood of the event, the geographical areas and populations likely to be impacted, and the health outcomes that could result
- examining the neurological health benefits and costs of new climate change mitigation technologies, including research on the toxicity of new metals and metal compounds, including nanotechnologies, being used to improve battery performance for electric vehicles

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9

Vectorborne and Zoonotic Diseases

Vectorborne and zoonotic diseases (VBZD) are infectious diseases whose transmission cycles involve animal hosts or vectors. Vectorborne diseases are those in which organisms, typically blood-feeding arthropods (insects, ticks, or mites) carry the pathogen from one host to another, generally with amplification (increased virulence) in the vector (for example, malaria). Zoonoses are diseases that can be transmitted from animals to humans by either contact with animals or by vectors that can carry zoonotic pathogens from animals to humans (for example, avian flu). Both domestic animals and wildlife, including marine mammals, fish, sea turtles, and seabirds may play roles in VBZD transmission by serving as zoonotic reservoirs for human pathogens or as means of interspecies transmission of pathogens. The epidemiology of VBZD in the United States has changed significantly over the past century, and many diseases that previously caused significant illness and death, including malaria,²⁴⁵ dengue,²⁴⁶ yellow fever,²⁴⁷ and murine typhus,²⁴⁸ are now rarely seen in this country. This dramatic change is a result of intentional programs to control vectors, vaccinate against disease, and detect and treat cases, with additional benefits from improvements in sanitation, development, and environmental modification. Examples of vectorborne diseases currently prevalent in the United States include Lyme disease²⁴⁹ and ehrlichiosis, bacterial diseases that are transmitted primarily by ticks. Other important zoonoses in the United States, some of which are also vectorborne, include rabies,²⁵⁰ Q fever,²⁵¹ anthrax, pathogenic *E. coli*, tularemia, hantavirus pulmonary syndrome,²⁵² and plague. Although VBZD currently are not a leading cause of morbidity or mortality in the United States, there is cause for some urgency on this issue. Our population is directly susceptible to the VBZD that circulate in warmer climates, and vulnerable as a result of global trade and travel. Our ability to respond to such threats on both a national and international level is currently limited.

Many vectorborne diseases that have been virtually eliminated from the industrialized world are still prevalent in developing countries. Globally, VBZD cause significant morbidity and mortality. For

RESEARCH HIGHLIGHT

Climate is one of several factors that influence the distribution of vectorborne and zoonotic diseases (VBZD) such as Lyme disease, Hantavirus, West Nile virus, and malaria. There is substantial concern that climate change will make certain environments more suitable for some VBZD, worsening their already significant global burden and potentially reintroducing some diseases into geographic areas where they had been previously eradicated. Recent public health experience with the outbreak and establishment of West Nile virus in the United States reveals the complexity of such epidemics, and the lack of preparedness required by public health officials to contain a national VBZD threat. Though unlikely, West Nile virus might have been contained when it emerged in New York City in 1999; however, delays of only a few weeks in recognizing the outbreak in birds and identifying the virus, combined with the absence of a robust mosquito abatement capability, allowed West Nile virus to spread quickly to surrounding areas. Relying on expertise from the mosquito abatement community, aerial spraying was applied fairly rapidly to combat mosquitoes in infected areas, but these efforts were not adequate to decrease populations of mosquitoes in time. From New York, the virus traveled across the entire United States, and by 2003, it had thoroughly established itself in the avian population. To date, individual mosquito abatement districts have been able to significantly protect their populations due to increased national funding combined with decades of experience in their local areas. However, underserved regions did not get significant protection despite efforts to identify them.

Resurgence of vectorborne disease as a result of climate change is also a major concern. Despite energetic interventions, the availability of drugs



245 Faust, E. in *Malariaology*; a comprehensive survey of all aspects of this group of diseases from a global standpoint, MF Boyd, Editor. 1949, Saunders: Philadelphia, p. 2 v. (xxi, 1643 p.).
 246 Adler, P, et al., *American Entomologist*, 2003. 49: p. 216-228.
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 250 Blanton, JD, et al., *J Am Vet Med Assoc*, 2008. 233(6): p. 884-97.
 251 McQuiston, JH, et al., *Am J Trop Med Hyg*, 2006. 75(1): p. 36-40.
 252 Douglass, RJ, et al., *Vector Borne Zoonotic Dis*, 2005. 5(2): p. 189-92.

example, in 2006 there were 247 million cases of malaria and 881,000 malaria-related deaths worldwide.²⁵³ The World Health Organization estimates that malaria is responsible for 2.9% of the world's total disability-adjusted life years (DALYs).²⁵⁴ In the long term, climate change's potential to cause social upheaval and population displacement may provide opportunities for resurgence of certain VBZD in the United States, which has already seen some redistribution of vector species.²⁵⁵ Disruption of economies, transportation routes, agriculture, and environmental services could result in large-scale population movements within and between countries, as well as a general decrease in what are now considered minimum standards of living.²⁵⁶ A severe degradation of rural and urban climate and sanitation conditions could bring malaria, epidemic typhus, plague, and yellow fever to their former prominence.

Valid projections on likely impacts of climate change on VBZD are lacking, and a scientific consensus has yet to emerge. Even though we now have the technical knowledge to treat or vaccinate against many VBZD, in the absence of these technologies, some experts believe that population-level mortality from certain disease outbreaks could reach as high as 20–50%.²⁵⁷ Ultimately, projections must be specific to location, altitude, ecosystem, and host or vector. Health impacts from changing distributions of VBZD are likely to unfold over the next several decades, and prevention and control activities must be developed and honed prior to significant vector range expansion in order to be most effective.

Emerging zoonotic disease outbreaks are increasing, with the majority of recent major human infectious disease outbreaks worldwide, as well as significant emerging diseases such as SARS, Nipah virus, and HIV/AIDS, originating in animals.²⁵⁸ A recent report noted that the United States remains the world's largest importer of wildlife, both legal and illegal; these animals represent a potential source of zoonotic pathogen introduction into U.S. communities.²⁵⁹ Interactions of wildlife with domestic animals and with people will likely increase in the United States due to changes to ecosystems and disease transmission resulting from both climate change and from adaptation and response strategies.

Impacts on Risks

VBZD ecology is complex, and weather and climate are among several factors that influence transmission cycles and human disease incidence.²⁶⁰ Impacts in certain ecosystems are better understood; however, for others such as marine ecosystems, their role in VBZD has not been well characterized.²⁶¹ Changes in temperature and precipitation patterns affect VBZD directly through pathogen-host-vector interactions, and indirectly through ecosystem changes (humidity, soil moisture, water temperature, salinity, acidity) and species composition. Social and cultural behaviors also affect disease transmission. Many VBZD exhibit some degree of climate sensitivity, and ecological shifts associated with climate variability and long-term climate change are expected to impact the distribution and incidence of many of these diseases.²⁶² For instance, the range of Lyme disease is expected to expand northward as the range of the deer tick that transmits it expands.²⁶³ In another example, the frequency of hantavirus pulmonary syndrome outbreaks, caused by human exposure to the virus in deer mice urine or feces, may change with increasingly variable rainfall in the desert Southwest, which affects the populations of deer mice and other rodents through changes in production of the pine nuts on which they feed.²⁶⁴

Similarly, certain VBZD may decrease in particular regions as habitats become less suitable for host or vector populations and for sustained disease transmission. Coastal and marine ecosystems will be particularly impacted by increasing temperatures, changes in precipitation patterns, sea-level rise, altered salinity, ocean acidification, and more frequent and intense extreme weather events. These changes will directly and indirectly affect ocean and coastal ecosystems by influencing community structure, biodiversity, and the growth, survival, persistence, distribution, transmission, and severity of disease-causing organisms, vectors, and reservoirs.²⁶⁵ Also of concern for both terrestrial and aquatic/marine ecosystems is the loss of biodiversity (which underlies ecosystem services) that further exacerbates the impacts of climate change on vectors or animal reservoir populations. Such alterations in ecosystem functions may alter the emergence of VBZD in populations within the United States. With the loss of predators, insect vectors may increase, making necessary either chemical or mechanical controls.

253 WHO. Global Malaria Programme. 2008. Geneva: World Health Organization. xx, 190 p.

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265 Niemi, G, et al., Environmental Health Perspectives, 2004. 112(9): p. 979-986.

Projecting VBZD incidence is difficult given the complexity of VBZD transmission cycles, the variability of regional and local impacts of climate change, and the limited information currently available regarding the ecology of many VBZD. For instance, while malaria transmission increases with temperature and humidity, the decrease in disease incidence seen with prolonged drought may negate these effects. Human rural and urban development efforts, such as the creation of clean water sources for animal husbandry or swamp clearance to increase availability of land for human settlement, also have significant impacts on transmission dynamics that can offset climate impacts.

The incidence of VBZD in the United States will likely increase under anticipated climate change scenarios, for several reasons. The distribution of vectors currently restricted to warmer climates will expand into the United States. For example, the habitats of two potent mosquito vectors of malaria, *Anopheles albimanus* and *Anopheles pseudopunctipennis*, currently range as far north as northern Mexico, and would presumably expand northwards across the U.S.–Mexico border.²⁶⁶ The extrinsic incubation period of pathogens in invertebrate vectors is highly dependent on ambient temperature. Since the lifespan of vector species is relatively constant, changes in the incubation period due to precipitation and temperature significantly alter the likelihood of transmission.²⁶⁷ Also, large disruption and subsequent movement of human populations create conditions for wider distribution of pathogens and greater exposure to vector species.²⁶⁸ And, climate change is already affecting the biodiversity of marine and terrestrial ecosystems, which in turn will alter the dynamics of predator–prey relationships, as well as vector and reservoir pathogen populations. This may alter the types and quality of subsistence animal foods, and present dependent communities with new pathogen risks.²⁶⁹ The time scale of this threat will be continuous unless mitigating measures are taken. Economic and regulatory restrictions continue to slow the development and use of new modes of action against vectors.

RESEARCH HIGHLIGHT continued

for treatment, and vector control strategies supported by strong scientific understanding, malaria continues to be a severe problem in Africa and a persistent one in Asia and Latin America. Malaria could present a threatened return to its former importance in more temperate climates.¹ Korea provides a recent case study with respect to the more chronic, less fatal species of the parasite, *Plasmodium vivax*.² Malaria became a severe problem on the Korean peninsula during and following the Korean War in 1950–1953. A combination of case detection, treatment, and vector control reduced the number of cases and finally eliminated the parasite from South Korea by 1988.³ The disease reemerged in 1993 and quickly became a problem in the military population by 1996, with cases of temperate-adapted parasites exported to the United States.⁴ Subsequent studies of the vector mosquitoes revealed that a complex of multiple species, including a powerful vector, *Anopheles anthropophagus* that is prevalent in China, is responsible for the reemergence. This reemergence may have been exacerbated by increases in severe rainfall events and temperature, but this has not yet been definitively established.⁵

The story is different in sub-Saharan Africa, where malaria is responsible for a large proportion of the infant and childhood mortality.⁶ Researchers have examined whether the wider distribution of malaria in highland regions is associated with climate change, and have performed quantitative predictions of the effects of various climate change scenarios on distribution of the disease.⁷ Climate change induced increases in temperature may have several effects: increase the altitude at which malaria transmission is possible, intensify transmission at lower altitudes, and generally make greater demands on the efficacy of vector control efforts.

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2 Ree, HI, *Korean J Parasitol*, 2000. 38(3): p. 119-38.

3 Paik, YH, et al., *Jpn J Exp Med*, 1988. 58(2): p. 55-66.

4 Feighner, BH, et al., *Emerg Infect Dis*, 1998. 4(2): p. 295-7.

5 Foley, DH, et al., *J Med Entomol*, 2009. 46(3): p. 680-92.

6 WHO. *Global Malaria Programme*. 2008, Geneva: World Health Organization. xx, 190 p.

7 Ebi, KL, et al., *Climatic Change*, 2005. 73(3): p. 375-393, Thomson, MC, et al., *Trends in Parasitology*, 2001. 17(9): p. 438-445, Zhou, G, et al., *Trends Parasitol*, 2005. 21(2): p. 54-6.

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268 Scoville, A. in *Rickettsial diseases of man; a symposium*, FR Moulton, Editor. 1948, American Association for the Advancement of Science: Washington, D.C., p. 247 p.

269 Niemi, G, et al., *Environmental Health Perspectives*, 2004. 112(9): p. 979-986, Jentsch, A, et al., *Comptes Rendus Geoscience*, 2008. 340(9-10): p. 621-628.

Mitigation and Adaptation

Climate change mitigation includes activities to reduce greenhouse gas emissions such as decreased reliance on fossil fuels for energy generation and transport and changes in land use such as reducing deforestation and conversion of forested land to cropland. Strategies focused on alternative energy sources with lower greenhouse gas emission profiles, such as nuclear power, may influence local ecologies by increasing water demands, temperature, and currents.^{270,271} This, in turn, might alter the life cycles of certain disease vectors and animals that are part of VBZD transmission cycles. Increased reliance on hydroelectric power, which typically requires construction of dams, also may change local VBZD ecologies and alter transmission cycles. Mitigation activities focused on land use changes, particularly preservation of forests and wetlands, are likely to impact VBZD ecology and transmission cycles as well.²⁷⁰ For example, changes to wetlands may affect mosquito burden in certain areas by altering breeding area size and potentially altering the incidence of malaria, dengue, or other mosquito-borne diseases.²⁷¹ Because the margins of disturbed ecosystems can be associated with outbreaks of zoonotic infections such as Ebola and Marburg viruses,²⁷² ecosystem preservation may also reduce the incidence of these VBZD. The net impact, either beneficial or detrimental, of these mitigations strategies on human health is difficult to determine, and more research is needed to elucidate these effects.

Climate change adaptation strategies include activities that provide early warning and reduce exposure to environmental hazards associated with climate change, and limit susceptibility in exposed populations. Some adaptation activities may impact VBZD or alter the potential for human exposure. For example, encouraging air conditioning use as an adaptation strategy against extreme heat may provide a co-benefit of reduced exposure to VBZD. The use of central air conditioning has been shown to be a protective factor against dengue infection in studies comparing dengue incidence on opposite sides of the U.S.-Mexico border.²⁷³ Negative impacts of adaptation are also possible. For example, capture and storage of water runoff to adapt to increasingly sporadic rainfall might provide more suitable breeding habitat for mosquitoes, thereby increasing incidence of West Nile virus and other VBZD.

Research Needs

Given the potential for significant increases in the burden of VBZD as a result of climate change, public health preparation is required, and research needs include:

- understanding of VBZD transmission cycles and the impact of ecological management and disruption on VBZD transmission, including the impact of new and intensified selective pressures due to climate change
- developing methods to detect, quantify, characterize, and monitor potential VBZD transmission associated with changes in terrestrial, ocean, coastal, and Great Lakes environments
- developing and validating models of VBZD ecology that link established datasets of VBZD disease transmission, identify relevant climate-related patterns, and integrate downscaled climate projections of likely impacts
- understanding of secondary effects of climate change such as increased malnutrition, conflict, and population displacement on VBZD, and evaluation of the effectiveness of prevention strategies
- enhancing research on the effectiveness of novel personal disease prevention methods including vaccines, repellents, bed nets, chemoprophylaxis, and others²⁷⁴
- developing new pesticides aimed at controlling disease vectors that combine the qualities of specificity (affecting only the target arthropods), adjustable persistence through formulation (chemically labile but persistent for useful periods), environmental safety (no bioaccumulation or effect on non-target organisms), low susceptibility to resistance (through either inherent physiology or effective resistance management techniques), and application to creative control strategies
- enhancing existing public health surveillance infrastructure to include longitudinal surveillance focused on the periphery of endemic areas to detect range expansion and on ports of entry (airports, seaports) where vectors may penetrate after long-distance travel
- enhancing existing animal health surveillance (both domestic animals and wildlife) and early detection of emerging diseases of animal origin with particular emphasis on increased human to wildlife contact

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273 Brunkard, JM, et al., *Emerging Infectious Diseases*, 2007. 13(10): p. 1477-1483, Reiter, P, et al., *Emerging Infectious Diseases*, 2003. 9(1): p. 86-89.

274 Strickman, D, et al. 2009, Oxford ; New York: Oxford University Press. xviii, 323 p., [8] p. of plates.

- developing early warning systems that integrate public and animal health surveillance, risk assessments, and mitigation and adaptation strategies related to VBZD transmission
- enhancing research on risk communication and prevention strategies related to VBZD outbreak response including evaluation of their effectiveness

The research needs identified for VBZD include crosscutting issues and opportunities for leveraging co-benefits. Enhanced surveillance capacity is transferable to other health categories. Deeper understanding of the ecology of VBZD will enable understanding of other ecosystems, and improve our ability to preserve ecosystem services and limit ecosystem mismanagement. Developing mathematical models of VBZD ecology and linking these models with downscaled climate projections will generate novel modeling methodologies, as well as new methods in spatial epidemiology and mapping, and enhance existing public health workforce capacity. Research into risk communication and prevention strategies for VBZD can be applied to other health risks, both climate-related and otherwise. Novel strategies for application of vector control will benefit public health and infrastructure development in general. Because vector abatement efforts require organization that reaches multiple levels (household, farm), such efforts will form an interactive customer base for the application of environmental tools such as spatial analysis and monitoring to other environmental services such as building code enforcement, water standards, and sanitation, as well as provide additional resources for gathering operational data on the status of populations.



10

Waterborne Diseases

Waterborne diseases are caused by a wide variety of pathogenic microorganisms, biotoxins, and toxic contaminants found in the water we drink, clean with, play in, and are exposed to through other less direct pathways such as cooling systems. Waterborne microorganisms include protozoa that cause cryptosporidiosis, parasites that cause schistosomiasis, bacteria that cause cholera and legionellosis, viruses that cause viral gastroenteritis, amoebas that cause amoebic meningoencephalitis, and algae that cause neurotoxicity.²⁷⁵ In the United States, the majority of waterborne disease is gastrointestinal, though waterborne pathogens affect most human organ systems and the epidemiology is dynamic. A recent shift has been seen in waterborne disease outbreaks from gastrointestinal toward respiratory infections such as that caused by *Legionella*, which lives in cooling ponds and is transmitted through air conditioning systems.²⁷⁶ In addition to diarrheal disease, waterborne pathogens are implicated in other illnesses with immunologic, neurologic, hematologic, metabolic, pulmonary, ocular, renal and nutritional complications.²⁷⁷ The World Health Organization estimates that 4.8% of the global burden of disease (as measured in disability-adjusted life years, or DALYs) and 3.7% of all mortality attributable to the environment is due to diarrheal disease.²⁷⁸ Most of these diseases produce more serious symptoms and greater risk of death in children and pregnant women.²⁷⁹

For most waterborne pathogens in the United States, surveillance is spotty, diagnoses are not uniform, and our understanding of the impact of normal weather and climate variation on disease incidence, as well as illness and death burdens, is not firmly established. Impacts of any intensifying of climate events at local, regional, national, and global levels are a growing concern. Experts estimate that there is a high incidence of mild symptoms from waterborne pathogens and a relatively small, but not negligible mortality burden.²⁸⁰

RESEARCH HIGHLIGHT

There is a clear association between increases in precipitation and outbreaks of waterborne disease, both domestically and globally. Climate change is expected to produce more frequent and severe extreme precipitation events worldwide. In the United States from 1948 to 1994, heavy rainfall correlated with

more than half of the outbreaks of waterborne diseases.¹ Some of the largest outbreaks of waterborne disease in North America, particularly in the Great Lakes, have resulted after extreme rainfall events. For example, in May 2000, heavy rainfall in Walkerton, Ontario resulted in approximately 2,300 illnesses and seven deaths after the town's drinking water became contaminated with *E. coli* O157:H7 and *Campylobacter jejuni*.² There are 734 combined sewage and wastewater systems in and around the Great Lakes, with an estimated discharge of 850 billion gallons of untreated overflow water.³ Using a suite of seven climate change models to project extreme precipitation events in the Great Lakes region, scientists have been able to estimate the potential impact of climate change on waterborne disease rates.⁴ Their models predict more than 2.5 inches of rain in a single day will cause a combined sewer overflow into Lake Michigan, resulting in 50–100% more waterborne disease outbreaks in the region per year. Considering that the Great Lakes serves as the primary water source for over 40 million people and is surrounded by a number of large cities, both past events and these projections indicate a serious threat to public health in this region due to climate change alterations in the frequency of extreme precipitation.



275 Batterman, S, et al., *Environ Health Perspect*, 2009. 117(7): p. 1023-32.

276 Yoder, J, et al., *MMWR Surveill Summ*, 2008. 57(9): p. 39-62.

277 Meinhardt, PL, *J Water Health*, 2006. 4 Suppl 1: p. 27-34.

278 Mathers, C, et al. 2008. Geneva, Switzerland: World Health Organization. vii, 146 p.

279 Ibid.

280 Craun, GF, et al., *J Water Health*, 2006. 4 Suppl 2: p. 101-19.

1 Curriero, FC, et al., *Am J Public Health*, 2001. 91(8): p. 1194-9.

2 Hrudey, SE, et al., *Water Science and Technology*, 2003. 47(3): p. 7-14.

3 US Environmental Protection Agency, Report to Congress: impacts and control of CSOs and SSOs. Office of Wastewater Management. 2004, US Environmental Protection Agency, Washington, DC.

4 Patz, JA, et al., *Am J Prev Med*, 2008. 35(5): p. 451-8.

Globally, the impact of waterborne diarrheal disease is high and expected to climb with climate change. Improving domestic surveillance is a high priority, as this would enhance epidemiologic characterization of the drivers of epidemic disease. In particular, weather and climate-related drivers are not well understood. Waterborne disease outbreaks are highly correlated with extreme precipitation events,²⁸¹ but this correlation is based on limited research and needs further investigation and confirmation. Prevention and treatment strategies for waterborne disease are well established throughout the developed world; climate change is not likely to greatly impact the efficacy of these strategies in the United States. However, climate change is very likely to increase global diarrheal disease incidence, and changes in the hydrologic cycle including increases in the frequency and intensity of extreme weather events and droughts may greatly complicate already inadequate prevention efforts. Enhanced understanding and reinvigorated global prevention efforts are very important.

Ocean-related diseases are those associated with direct contact with marine waters (aerosolized in some cases) or sediments (including beach sands), ingestion of contaminated seafood, or exposure to zoonotics.²⁸² Pathogenic microorganisms (bacteria, viruses, protozoa, and fungi) that may occur naturally in ocean, coastal, and Great Lakes waters, or as a result of sewage pollution and runoff, are the primary etiologic agents.²⁸³ Human exposure to these agents may result in a variety of infectious diseases including serious wound and skin infections, diarrhea, respiratory effects, and others.²⁸⁴ Research has concluded that the antibiotic resistant methicillin resistant *Staphylococcus aureus* (MRSA) is persistent in both fresh and seawater and could become waterborne if released into these waters in sufficient quantities.²⁸⁵ While this has yet to emerge as a significant public health concern, the potential for recreational exposure is significant, as people make nearly one billion trips to the beach annually in the United States alone. In contrast to diarrheal disease, there are few effective preventive strategies for marine-based environmental exposures beyond

closing beaches to the public, and these areas need immediate additional research.

The effects of climate changes on the distribution and bioaccumulation of chemical contaminants in marine food webs are poorly understood and may be significant for vulnerable populations of humans and animals. The U.S. Climate Change Science Program (CCSP) reported a likely increase in the spread of waterborne pathogens depending on the pathogens' survival, persistence, habitat range, and transmission in a changing environment.²⁸⁶ In one specific example, the CCSP noted the strong association between sea surface temperature and proliferation of many *Vibrio* species and suggested that rising temperatures would likely lead to increased occurrence of enteric disease associated with *Vibrio* bacteria (*V. cholerae*, *V. vulnificus*, and *V. parahaemolyticus*) in the United States, including the potential for the occurrence of cholera and wound infections. Further, recent findings demonstrate that pathogens that can pose disease risks to humans occur widely in marine vertebrates and regularly contaminate shellfish and aquacultured finfish.²⁸⁷

Impacts on Risk

Climate directly impacts the incidence of waterborne disease through effects on water temperature and precipitation frequency and intensity. These effects are pathogen and pollutant specific, and risks for human disease are markedly affected by local conditions, including regional water and sewage treatment capacities and practices. Domestic water treatment plants may be susceptible to climate change leading to human health risks. For example, droughts may cause problems with increased concentrations of effluent pathogens and overwhelm water treatment plants; aging water treatment plants are particularly at risk.²⁸⁸ Urbanization of coastal regions may lead to additional nutrient, chemical, and pathogen loading in runoff.²⁸⁹

286 Ebi, K, et al. in Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, J Gamble, et al., Editors. 2008, USEPA: Washington, D. C.

287 Moore, SK, et al., Environmental Health: A Global Access Science Source, 2008. 7(SUPPL. 2).

288 Kistermann, T, et al., Applied and Environmental Microbiology, 2002. 68(5): p. 2188-2197, Patz, JA, et al., Am J Prev Med, 2008. 35(5): p. 451-8, Senhorst, HAJ, et al., Water Science and Technology, 2005. 51(5): p. 53-59, Wilby, R, et al., Weather, 2005. 60(7): p. 206-211.

289 Dwight, RH, et al., American Journal of Public Health, 2004. 94(4): p. 565-567, Dwight, RH, et al., Water Environment Research, 2002. 74(1): p. 82-90, Semenza, JC, et al., Lancet Infectious Diseases, 2009. 9(6): p. 365-375.

281 Curriero, FC, et al., Am J Public Health, 2001. 91(8): p. 1194-9.

282 Heaney, CD, et al., Am J Epidemiol, 2009. 170(2): p. 164-72.

283 Mos, L, et al., Environ Toxicol Chem, 2006. 25(12): p. 3110-7.

284 Stewart, JR, et al., Environ Health, 2008. 7 Suppl 2: p. 53.

285 Tolba, O, et al., Int J Hyg Environ Health, 2008. 211(3-4): p. 398-402.

Our understanding of weather and climate impacts on specific pathogens is incomplete. Climate also indirectly impacts waterborne disease through changes in ocean and coastal ecosystems including changes in pH, nutrient and contaminant runoff, salinity, and water security. These indirect impacts are likely to result in degradation of fresh water available for drinking, washing food, cooking, and irrigation, particularly in developing and emerging economies where much of the population still uses untreated surface water from rivers, streams, and other open sources for these needs. Even in countries that treat water, climate-induced changes in the frequency and intensity of extreme weather events could lead to damage or flooding of water and sewage treatment facilities, increasing the risk of waterborne diseases. Severe outbreaks of cholera, in particular, have been directly associated with flooding in Africa and India.²⁹⁰ A rise in sea level, combined with increasingly severe weather events, is likely to make flooding events commonplace worldwide. A 40 cm rise in sea level is expected to increase the average annual numbers of people affected by coastal storm surges from less than 50 million at present to nearly 250 million by 2080.²⁹¹

Several secondary impacts are also a concern. Ecosystem degradation from climate change will likely result in pressure on agricultural productivity, crop failure, malnutrition, starvation, increasing population displacement, and resource conflict, all of which are predisposing factors for increased human susceptibility and increased risk of waterborne disease transmission due to surface water contamination with human waste and increased contact with such waters through washing and consumption.^{292,293}

Climate change may also affect the distribution and concentrations of chemical contaminants in coastal and ocean waters, for example through release of chemical contaminants previously bound up in polar ice sheets or sediments, through changes in volume and composition of runoff from coastal and watershed development, or through changes in coastal and ocean goods and services. Both naturally occurring and pollution-related ocean health threats will

likely be exacerbated by climate change.²⁹⁴ Other climate-related environmental changes may impact marine food webs as well, such as pesticide runoff, leaching of arsenic, fluoride, and nitrates from fertilizers, and lead contamination of drinking and recreational waters through excess rainfall and flooding.

Mitigation and Adaptation

Alternative energy production, carbon sequestration, and water reuse and recycling are some of the mitigation and adaptation options that could have the greatest implications for human health. As with all technologies, the costs and benefits of each will need to be carefully considered and the most beneficial implemented.

The potential impacts of different mitigation strategies for waterborne illness depend on the strategy. For instance, increased hydroelectric power generation will have significant impacts on local ecologies where dams are built, often resulting in increased or decreased incidence of waterborne disease, as was the case with schistosomiasis (increase) and haematobium infection (decrease) after construction of the Aswan Dam in Egypt.²⁹⁵ Other modes of electric power generation, including nuclear, consume large quantities of water and have great potential environmental impacts ranging from increased water scarcity to discharge of warmed effluent into local surface water bodies. Shifting to wind and solar power, however, will reduce demand on surface waters and, therefore, limit impacts on local water ecosystems and potentially reduce risks of waterborne diseases. The impacts on waterborne pathogen ecology of other geoengineering mitigation strategies, such as carbon sequestration, have the potential to be substantial but are currently largely unknown.²⁹⁶ Thorough health impact and environmental impact assessments are necessary prior to implementation and widespread adoption of any novel mitigation technology.

There is also significant potential for adaptation activities to impact the ecology of waterborne infectious disease. Certain adaptation strategies are likely to have a beneficial impact on water quality; for instance, protecting wetlands to reduce damage from severe storms.

290 Sidley, P, BMJ, 2008. 336(7642): p. 471, Sur, D, et al., Indian J Med Res, 2000. 112: p. 178-82.

291 Ford, TE, et al., Emerging Infectious Diseases, 2009. 15(9): p. 1341-1346.

292 Shultz, A, et al., American Journal of Tropical Medicine and Hygiene, 2009. 80(4): p. 640-645.

293 Diaz, JH, Am J Disaster Med, 2007. 2(1): p. 33-42.

294 Sandifer, P, et al., Interagency oceans and human health research implementation plan: a prescription for the future. 2007, Interagency Working Group on Harmful Algal Blooms, Hypoxia and Human Health of the Joint Subcommittee on Ocean Science and Technology: Washington, DC, USA.

295 Abdel-Wahab, MF, et al., Lancet, 1979. 2(8136): p. 242-4.

296 White, CM, et al., Energy & Fuels, 2005. 19(3): p. 659-724.

Under drought conditions, water reuse or the use of water sources that may be of lower quality is likely to increase.²⁹⁷ Local water recycling and so-called grey-water reuse, as well as urban design strategies to increase green space and reduce runoff, may result in slower rates of water table depletion and reduce the impact of extreme precipitation events in urban areas where runoff is concentrated.

Other adaptation efforts may have both positive and negative effects. For instance, if the response to increasingly frequent and severe heat waves is widespread adoption of air conditioning, the associated increase in electricity demand will require additional power, which in turn could impact water availability and regional water ecology. In parts of the developing world, changing weather patterns and decreased food availability could lead to increased desertification, or at the least the need for more above-ground irrigation. If such projects are implemented in areas where parasitic diseases such as schistosomiasis are prevalent without close attention to potential ecosystem impacts, there may be changes in regional parasite transport and associated increases or decreases in human exposure.

Climate-induced changes to coastal ecosystems are poorly understood, especially with regard to ecosystem goods and services related to human health and well being, and ocean and coastal disease threats.²⁹⁸ Interactions among climate change factors such as rising temperature, extreme weather events, inundation, ocean acidification, and changes in precipitation and runoff with coastal development, aquacultural practices, and other water use issues need to be studied.

Research Needs

The extent to which the United States is vulnerable to increased risk of waterborne diseases and ocean-related illness due to climate change has not been adequately addressed.²⁹⁹ Research needs include:

- understanding the likelihood and potential magnitude of waterborne disease outbreaks due to climate change including increases in the frequency and intensity of precipitation, temperature changes, extreme weather events, and storm surges
- researching the vulnerability of water systems to sewer overflow or flooding caused by extreme weather events, especially in water systems where there is already considerable water reuse; and examining the impacts of other water reuse and recycling strategies
- understanding how toxins, pathogens, and chemicals in land-based runoff and water overflow interact synergistically and with marine species, especially those important for human consumption, and the potential health risks of changing water quality
- developing means of identifying sentinel species for waterborne disease and understanding of how they may provide early warning of human health threats
- developing or improving vaccines, antibiotics and other preventive strategies to prevent and reduce the health consequences of waterborne disease on a global basis
- improving understanding of harmful algal blooms including their initiation, development, and termination, as well as the exact nature of the toxins associated with them

297 Corwin, DL, et al., *J Environ Qual*, 2008. 37(5 Suppl): p. 51-7.

298 United States. Congress. Senate. Committee on Commerce Science and Transportation. 2003, Washington: U.S. G.P.O. ii. 8 p.

299 Frumkin, H, et al., *American Journal of Public Health*, 2008. 98(3): p. 435-445, Ebi, K, et al., in *Analyses of the effects of global change on human health and welfare and human systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research*, J Gamble, et al., Editors. 2008, USEPA: Washington, D. C., Sandifer, P, et al., *Interagency oceans and human health research implementation plan: a prescription for the future*. 2007, Interagency Working Group on Harmful Algal Blooms, Hypoxia and Human Health of the Joint Subcommittee on Ocean Science and Technology: Washington, DC, USA.

- conducting epidemiologic studies on the occurrence and severity of ocean-related diseases among humans, especially high risk populations, in relation to climate change
- evaluating and monitoring exposures and health risks of chemical contaminants likely to be increasingly released and mobilized due to climate change
- improving methods to detect, quantify, and forecast ocean-related health threats including improved surveillance and monitoring of disease-causing agents in coastal waters; in marine organisms (especially seafood), aerosols, and sediments; and in exposed human populations
- assessing the capacity of the nation's public health infrastructure to detect and respond to increased waterborne disease incidence, and developing training and evaluation tools to address identified gaps



EVACUATION
ROUTE



11

Weather-Related Morbidity and Mortality

The United States experiences a variety of extreme weather events ranging from hurricanes and floods to blizzards and drought. Many of these events cause severe infrastructure damage and lead to significant morbidity and mortality. From 1940 to 2005, hurricanes caused approximately 4,300 deaths and flooding caused 7,000 deaths, primarily from injuries and drowning.³⁰⁰ Climate change is expected to increase the frequency and intensity of some extreme weather events, including floods, droughts, and heat waves, though how these events will manifest on a regional level is uncertain.³⁰¹ The health impacts of these extreme weather events can be severe, and include both direct impacts such as death and mental health effects, and indirect impacts such as population displacement and waterborne disease outbreaks such as the 1993 Milwaukee cryptosporidium outbreak caused by flooding that sickened an estimated 400,000 people.^{302,303}

The populations most at risk from such extreme events also are growing, particularly as a result of increased coastal development, as recent flooding events and hurricanes have shown. Sea-level rise associated with climate change will amplify the threat from storm surge associated with extreme weather events in coastal areas.³⁰⁴ Other areas, such as the Southwest, are at risk for decreased agricultural productivity due to increased drought and possible compromise of potable water supplies due to flooding from heavy precipitation events.³⁰⁵ Given the increased incidence of extreme weather events and the increasing number of people at risk, research in this area is an immediate and significant need. Preparation has a significant impact on outcomes of extreme weather events. Poor preparedness and response to Hurricane Katrina led to increased morbidity and mortality, as well as economic costs associated with recovery, which were estimated to be in excess of \$150 billion.³⁰⁶

By increasing research funding related to extreme weather events,

increased preparedness levels could lower costs and minimize morbidity and mortality from future events.

Impacts on Risk

A changing climate coupled with changing demographics is expected to magnify the already significant adverse effects of extreme weather on public health. For example, the intensity and frequency of precipitation events in the United States have increased over the past 100 years in many locations.³⁰⁷ In the Midwest and Northeastern United States, heavy rainfall events (defined as those in excess of 1 inch of rainfall) have increased by as much as 100%, and recent flooding events, such as the June 2008 flooding in the Midwest, have caused billions of dollars of damage and significant loss of life.³⁰⁸ In line with this observed trend, there is a projected increase in intensity of precipitation events in some areas of the country, particularly in the Northeast, which has experienced a 67% increase in the amount of heavy precipitation events in the past 50 years.^{309,310} Precipitation extremes also are expected to increase more than the mean. Regional variability appears to be increasing so that even though extreme precipitation events will become more common, some areas will concurrently experience drought, especially in the northeast and southwest.³¹¹

The intensity of extreme precipitation events is projected to increase with future warming.³¹² This could limit the ability to capture and store water in reservoirs, leading to flash flooding events. Climate variability resulting from naturally occurring climate phenomena such as El Niño, La Niña, and global monsoons, are associated with extreme weather events around the globe.³¹³ El Niño and La Niña conditions lead to changes in the patterns of tropical rainfall

300 Ashley, ST, et al., *Journal of Applied Meteorology and Climatology*, 2008. 47(3): p. 805-818, National Weather Service, Summary of Natural Hazard Statistics for 2007 in the United States. 2007: Washington.

301 Greenough, G, et al., *Environmental Health Perspectives*, 2001. 109: p. 191-198, Trenberth, KE, et al., *Bulletin of the American Meteorological Society*, 2003. 84(9): p. 1205-+.

302 Mac Kenzie, WR, et al., *N Engl J Med*, 1994. 331(3): p. 161-7.

303 Greenough, G, et al., *Environmental Health Perspectives*, 2001. 109: p. 191-198, Mills, DM, *Journal of Occupational and Environmental Medicine*, 2009. 51(1): p. 26-32, Verger, P, et al., *Journal of Exposure Analysis and Environmental Epidemiology*, 2003. 13(6): p. 436-442.

304 Karl, T, et al., *Weather and climate extremes in a changing climate regions of focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands*, in *Synthesis and assessment product 3.3*. 2008, U.S. Climate Change Science Program: Washington, DC. p. x, 162 p.

305 Ibid.

306 Burton, M, et al., *Hurricane Katrina: Preliminary estimates of commercial and public sector damages*. 2005, Center for Business and Economic Research, Marshall University: Huntington, WV.

307 Karl, T, et al. 2009, New York: Cambridge University Press, Kunkel, KE, *Natural Hazards*, 2003. 29(2): p. 291-305.

308 Black, H, *Environmental Health Perspectives*, 2008. 116(9): p. A390-+, Kunkel, KE, et al., *Journal of Climate*, 1999. 12(8): p. 2515-2527.

309 Kunkel, KE, *Natural Hazards*, 2003. 29(2): p. 291-305, Balling, RC, et al., *Natural Hazards*, 2003. 29(2): p. 103-112, Groisman, PY, et al., *Climatic Change*, 1999. 42(1): p. 243-283.

310 Meehl, G, et al., *GAAs*, T. F. and Collins, W. D. and Friedlingstein, A. T. and Gaye, A. T. and Gregory, J. M. and Kitoh, A. and Knutti, R. and Murphy, J. M. and Noda, A. and Raper, S. C. B. and Watterson, I. G. and Weaver, A. J. and Zhao, Z. in *Climate change 2007: the physical science basis: contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, S Solomon, et al., Editors. 2007, Cambridge University Press: Cambridge; New York. p. 747-845.

311 Christensen, JH, et al. Ibid. Hayhoe, K, et al., *Climate Dynamics*, 2007. 28(4): p. 381-407, Milly, PCD, et al., *Nature*, 2005. 438(7066): p. 347-350.

312 Meehl, G, et al., *GAAs*, T. F. and Collins, W. D. and Friedlingstein, A. T. and Gaye, A. T. and Gregory, J. M. and Kitoh, A. and Knutti, R. and Murphy, J. M. and Noda, A. and Raper, S. C. B. and Watterson, I. G. and Weaver, A. J. and Zhao, Z. in *Climate change 2007: the physical science basis: contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, S Solomon, et al., Editors. 2007, Cambridge University Press: Cambridge; New York. p. 747-845.

313 Karl, T, et al., *Weather and climate extremes in a changing climate regions of focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands*, in *Synthesis and assessment product 3.3*. 2008, U.S. Climate Change Science Program: Washington, DC. p. x, 162 p.

and in the weather patterns in mid-latitudes, including changes in the frequency and intensity of weather extremes. El Niño is also projected to increase in both frequency and intensity as the climate warms, though there is uncertainty about the relative frequency of El Niño and La Niña in the future. Increased precipitation associated with stronger El Niño events would affect the Western United States, particularly California, the Pacific Northwest, and the Gulf Coast more than other regions of the country.³¹⁴

Heavy precipitation events will be highly variable in magnitude, duration, and geographic location. Increased variability in weather and climate extremes is difficult to predict, and will impact the ability of human systems to manage for and adapt to heavy precipitation and flooding events. An observed divergence of precipitation patterns has led to increased variability in the amount of precipitation per event, resulting in both extreme amounts of precipitation, as well as abnormally small precipitation events.³¹⁵ These effects have already been observed globally. A study in Germany found that winter storms from 1901 to 2000 showed an increasing trend of precipitation events both exceeding the 95th percentile and falling below the 5th percentile; while from 1956 to 2004 the Dongxiang River in China became increasingly likely to be at either extreme flood flow or abnormally low-flow.³¹⁶

The current evidence is insufficient to determine if the frequency of tropical cyclones in the Atlantic Basin will change. The observed frequency of tropical cyclones in the Atlantic Basin has increased since the mid-1990s, though the numbers are not unprecedented and must be reconciled with active multi-decadal periods of the past, such as the 1950s and 1960s.³¹⁷ Increases in sea surface temperature and decreases in wind shear may lead to more intense Atlantic hurricanes, though some models also show a decrease in the number of intense hurricanes in the Atlantic Basin.

The spatial distribution of hurricanes also is likely to change, with storm surges becoming more damaging in areas unaccustomed to facing large hurricanes. The combination of sea-level rise with increasing storm intensity could lead to significant destruction of coastal

infrastructure and more costly hurricanes.³¹⁸ In addition, flooding and coastal changes could lead to ecosystem changes such as loss of wetlands that could indirectly impact human health. Hurricane track forecasting and modeling methods have improved, and mortality rates for major storms have declined over time, but the combination of increased coastal population density, increased intensity of tropical storms, and sea-level rise will result in significantly increased risk going forward.³¹⁹

Some models show that what were 20-year floods in 1860 in the United Kingdom are now 5-year floods; even greater impacts are expected in tropical regions.³²⁰ In the United States, large floods are more frequent now than at the beginning of the 20th century.³²¹ Monsoon-related flooding results in damaged infrastructure, increased disease, and loss of life. During El Niño, areas including Indonesia, southern Africa, northeastern Australia, and northeastern Brazil usually experience extensive periods of dry weather and warmer-than-average temperatures.³²² These conditions have historically resulted in a variety of adverse effects, such as mudslides, forest fires and resulting increased air pollution, mass migrations, and famines.³²³

Mitigation and Adaptation

Climate change mitigation includes activities that reduce greenhouse gas emissions. Important sources include land use changes, transport, energy production, and buildings. Some proposed mitigation strategies to reduce the occurrence of extreme weather events could impact human health. A reduction in personal automobile usage is one way to lower carbon emissions. However, a greater reliance on public transportation could either improve or reduce the ability to quickly evacuate a city prior to a severe weather event, depending on how it is managed. Mitigation activities related to land use may have other health impacts; anthropogenic reforestation, when combined with shifting weather patterns, could provide habitats for zoonotic and vectorborne diseases while reducing land available for agricultural uses. It is difficult to adequately evaluate the likely health impacts of various mitigation strategies, though Health Impact Assessments are proving a very useful public health tool for this purpose.

314 Ibid, Easterling, DR, et al., Science, 2000. 289(5487): p. 2068-2074.

315 Jentsch, A, et al., Comptes Rendus Geoscience, 2008. 340(9-10): p. 621-628, Christensen, JH, et al. in Climate change 2007 : the physical science basis : contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, S Solomon, et al., Editors. 2007, Cambridge University Press: Cambridge ; New York. p. 747-845.

316 Tromel, S, et al., Theoretical and Applied Climatology, 2007. 87(1-4): p. 29-39, Wang, W, et al., Hydrology and Earth System Sciences, 2008. 12(1): p. 207-221.

317 Karl, T, et al., Weather and climate extremes in a changing climate regions of focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands, in Synthesis and assessment product 3.3. 2008, U.S. Climate Change Science Program: Washington, DC. p. x, 162 p, Henderson-Sellers, A, et al., Bulletin of the American Meteorological Society, 1998. 79(1): p. 19-38, Knutson, T, et al. in Culture Extremes and Society. 2008, Cambridge University Press: Cambridge.

318 Meehl, GA, et al., Collins, W. D. and Friedlingstein, A. T. and Gaye, A. T. and Gregory, J. M. and Kitoh, A. and Knutti, R. and Murphy, J. M. and Noda, A. and Raper, S. C. B. and Watterson, I. G. and Weaver, A. J. and Zhao, Z. in Climate change 2007 : the physical science basis : contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, S Solomon, et al., Editors. 2007, Cambridge University Press: Cambridge ; New York. p. 747-845.

319 Rappaport, EN, et al., Weather and Forecasting, 2009. 24(2): p. 395-419.

320 Allen, MR, et al., Nature, 2002. 419(6903): p. 224-+.

321 Trenberth, KE, et al., Bulletin of the American Meteorological Society, 2003. 84(9): p. 1205-+, Milly, PCD, et al., Nature, 2005. 438(7066): p. 347-350.

322 Karl, T, et al., Weather and climate extremes in a changing climate regions of focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands, in Synthesis and assessment product 3.3. 2008, U.S. Climate Change Science Program: Washington, DC. p. x, 162 p.

323 Planton, S, Médecine Et Maladies Infectieuses, 1999. 29(5): p. 267-276.

There are several adaptation strategies for extreme weather events that have proven effective, including early warning systems, zoning and planning to avoid building in at-risk areas, reinforcing the built environment against hazardous weather events, and evacuation planning. While some strategies may be costly, they can be implemented over extended periods of time, defraying their costs. However, adaptation could be more difficult in some of the most heavily affected areas. For example, the population of many cities along the relatively high-risk U.S. Eastern seaboard has been growing in recent years and this growth is likely to continue. High population growth, typically associated with concentrations of critical infrastructure, in areas vulnerable to storm surges and sea-level rise will make adaptation difficult. Moreover, some adaptation activities intended to preserve existing infrastructure, such as building levees and other flood control measures, may have adverse ecological impacts and be prohibitively expensive. Alternatively, measures to fortify natural barriers to flooding and erosion and to buffer storm surge, such as wetlands and tidal marshes, will decrease the magnitude of adverse exposures and maintain associated ecosystem services such as food production and waste assimilation, thereby realizing potential co-benefits of climate change adaptation.

Research Needs

Due to the complexity of climate change and the health effects associated with climate variability and extreme weather, research needs in this area are diverse, and include:

- exploring the impact of extreme precipitation events on waterborne disease, particularly cholera, and on the ecology of vectorborne and zoonotic disease
- improving understanding of extreme weather events associated with naturally occurring climate phenomena such as El Niño, La Niña, and monsoons, and their impacts on human health
- assessing the ability of health care systems to respond to extreme weather events and provide uninterrupted access to and delivery of health care services under a variety of scenarios
- improving understanding of how to anticipate and address food security and nutrition issues after extreme weather events, domestically and globally
- improving understanding of how to anticipate and address water quality and availability concerns associated with extreme weather events, domestically and globally

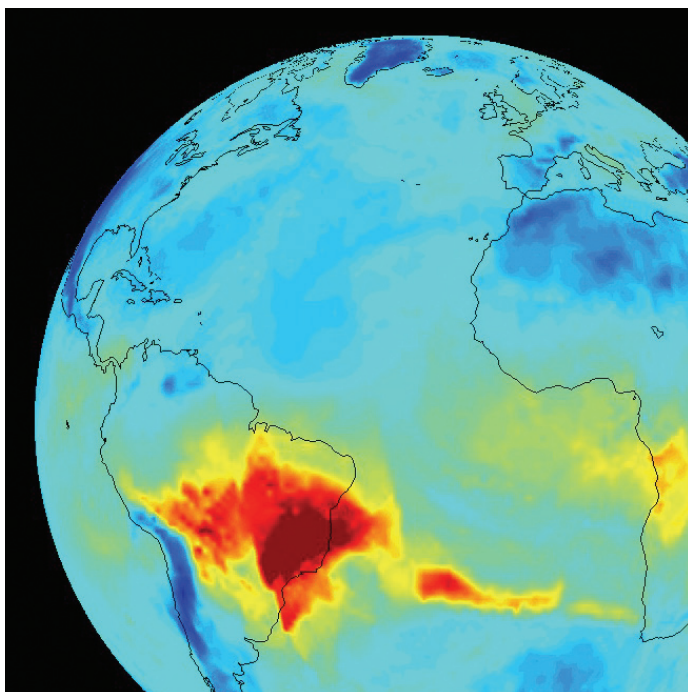
- developing strategies for linking health databases³²⁴ with real-time monitoring and prospective assessment of weather, climate, geospatial, and exposure data³²⁵ in order to better characterize the health impacts of extreme weather events
- improving the predictive power of probabilistic modeling of health effects of extreme events such as droughts, wildfires, and floods
- enhancing predictability, modeling, and ongoing assessment of the effects of climate variability and change (seasonal-to-interannual and decadal) on extreme events and correlation with short- and long-term health outcomes
- developing and validating downscaling techniques from global climate models to provide regional information for health early warning systems
- transitioning research advances into operational products and decision support tools for health early warning systems
- evaluating and improving the effectiveness of health alert warning systems and other health system risk communication tools such as evacuation protocols and National Disaster Management System activation, particularly for high-risk populations
- expanding research on prevention and preparedness for extreme weather events including development of disaster planning tools such as data and communication systems for public health and emergency care, including enhanced access to medical records and capabilities across hospitals on a regional level
- evaluating and developing new funding and reinsurance strategies and policies for disaster relief and rebuilding infrastructure

Weather related research intersects with several other areas of climate change research. Examples include waterborne and vectorborne illness following floods and hurricane storm surges, as well as post-traumatic stress disorder and related mental effects that can result from personal tragedy and displacement after extreme weather events. Studies of marine ecosystems and associated health impacts also overlap with extreme weather studies. Research in health communications and early warning systems is clearly applicable to periods proceeding and following weather disasters, as well as disaster preparedness and critical infrastructure development and protection

324 such as the databases maintained by the National Center for Health Statistics

325 such as the databases included in the Global Earth Observation System of Systems initiative and those maintained by the US EPA and NOAA

Synthesis and Recommendations



There is abundant evidence that human activities are altering the earth's climate and that climate change will have significant health impacts both domestically and globally. While all of the changes associated with this process are not predetermined, the actions we take today will certainly help to shape our environment in the decades to come. Some degree of climate change is unavoidable, and we must adapt to its associated health effects; however, aggressive mitigation actions can significantly blunt the worst of the expected exposures. Still, there will be effects on the health of people in the United States, some of which are probably already underway. As great as the domestic risks to U.S. public health are, the global risks are even greater.

Climate change and health issues transcend national borders, and climate change health impacts in other countries are likely to affect health in the United States as well. Famine, drought, extreme weather events, and regional conflicts—all likely consequences of climate change—are some of the factors that increase the incidence and severity of disease, as well as contributing to other adverse health impacts, making it imperative to address climate change-related decision making at local, regional, national, and global levels. The complicated interplay of these and other factors must be considered in determining the scope and focus of both basic and applied research on climate change and health.

There are significant research needs to help direct adaptation activities and inform mitigation choices going forward. Such needs include integrating climate science with health science; integrating environmental, public health, and marine and wildlife surveillance; applying climate and meteorological observations to real-time public health issues; and down-scaling long-term climate models to estimate human exposure risks and burden of disease. Integrated data systems should incorporate a breadth of environmental parameters, as well as sociodemographic parameters such as population, income, and education.

Several overarching themes emerged during the creation of this document including: systems and complexity, risk communication and public health education, co-benefits of mitigation and adaptation strategies, and urgency and scope. These are discussed below.

Systems and Complexity. The complicated links between human and natural systems need to be better understood so public health agencies can develop evidence-based prevention strategies and the health care community can pursue secondary controls and respond to health incidents when prevention is not effective. Research on these links should focus not only on the direct health effects of climate change but also on the complex relationships between different exposure pathways and health risks. For example, people with compromised immune systems because of persistent organic pollutant exposure are likely to be at greater risk of infection and death from vectorborne, waterborne, and foodborne pathogens and disease. Similarly, people with respiratory illnesses such as asthma and chronic obstructive pulmonary disease are far more likely to suffer distress and hospitalization during extreme heat events, dust storms, or high pollen events than healthy people. Thus, the structure of basic research on health impacts should address the combined

effects of multiple environmental changes and stressors, some caused by climate change and some by other factors, facilitating a robust public health and health care response.

Given the fundamental importance of ecosystems in climate change impacts and the significant roles that environmental factors play in human health, climate change and health research should also focus on the complex interplay between risk, location, and environmental conditions. Vulnerability and resilience to climate change health effects are both heavily determined by locality. A huge amount of diverse information will be needed at all governance levels (local, regional, national, global). Understanding local needs will be of greatest importance, given that effective adaptation strategies likely will not be universally applicable to all locations. However, there is also a need to identify common elements of strategies that may be generalized from one community to another. In addition, research is needed on how to identify common features of locales that will help identify them as having similar responses to climate change, how to determine and develop optimal strategies for interventions, and how to develop and implement communication tools that will effectively help communities respond to their particular situation.

Risk Communication and Public Health Education.

Knowledge is one of the most strategic tools in reducing health problems in any environment; it allows us to understand what is harmful, why, and possibly how to avoid such harm. Research is critical, but knowledge that is not effectively communicated to appropriate audiences is wasted. Knowledge of the health impacts associated with climate change will have limited value without effective communication and education strategies to increase public awareness and understanding of the specific risks involved and the complexity of the issues. Communication with particularly vulnerable individuals and populations, as well as with health care professionals and public health officials tasked with protecting communities, is itself deserving of further research. For example, public health agencies already warn people with pulmonary diseases to avoid lengthy exposure outdoors on days of high ozone. Such warning systems might be more effective if delivered through multiple channels and tailored to individual health risks. Warnings on other harmful environmental exposures such as high pollen concentrations and extreme heat events should be expanded in geographic scope. For at-risk patients,

warnings could be integrated into hospital and clinic discharge instructions or distributed with medications to more effectively prevent exacerbations of environmentally sensitive disease. Public health professionals need to be highly vigilant for opportunities to increase the range and impact of early warning systems on vulnerable populations. As our health care system is increasingly integrated and preventive health activities become more robust, there will be ever more opportunities to prevent adverse health effects associated with harmful environmental exposures. Risk communication efforts need to be culturally sensitive to provide appropriate and effective guidance, and potential interventions require testing and evaluation before they are implemented.

Mitigation and Adaptation. Considerable discussion currently focuses on identifying mitigation strategies that balance the economic costs of emission reductions (both direct mitigation costs and costs associated with loss of productivity) with the costs of environmental degradation from continuing business as usual. Examples of mitigation technologies include electric cars, alternative fuels, and green urban development. Cost-benefit evaluations typically express costs in economic terms rather than in terms of human morbidity and mortality, though these health impacts can be substantial. Many mitigation and adaptation strategies reach across health endpoints and may be both beneficial and problematic for a wide array of diseases.

Climate change health impacts are complicated and not always intuitive or unidirectional. For example, reducing reliance on fossil fuels in the transportation sector will substantially reduce CO₂ emissions, which over time will reduce the effects of climate change on human health. Thus, consideration of the costs of emissions reductions should include reduced health cost due to effective mitigation. Failing to mitigate also carries additional health consequences beyond those associated with climate change itself. For example, reducing vehicular emissions improves air quality, which may lessen incidences of effects such as airway diseases and irritations, cardiovascular disease, and cancer. However, further research, including life cycle analyses of batteries and other technologies, and human exposure to novel emission mixtures, is needed to avoid unintended negative consequences. If we choose not to reduce greenhouse gas emissions from transportation, levels of air pollution generated by vehicles will remain high and the cardiovascular, respiratory,

and cancer morbidity and mortality associated with vehicular air pollution will continue and probably increase. This example illustrates the importance of understanding the potential co-benefits of climate change mitigation efforts so that optimal strategies can be implemented. Basic research on health and environmental factors and implementation research to develop new models and paradigms for burden-of-disease calculations are needed to allow for a careful use of health and economic cost indicators in the same evaluation. Health impact assessments are an important tool for evaluating the health impacts, both positive and negative, of possible mitigation strategies prior to widespread implementation.

Similarly, there is considerable need for study of broader adaptation issues that will affect many different groups. Examples of adaptation include use of air conditioning, weather alerts, and increased numbers of medical facilities. Of key interest are the health effects of adaptation practices in food, water, and chemical use. For example, regional water shortages will cause a greater intensity of recycling and reuse of water, with resulting increases in risks of human exposure to waterborne pollutants and pathogens. The genetic modification of plants to withstand altered environments and use less water could introduce changes in the allergenicity or toxicity of foods that are currently considered harmless. And use of pesticides whose residues may be harmful to both current and future generations may increase as a way of adapting to the effects of increasing temperatures and changing precipitation patterns that affect crop yields. Other adaptation efforts may have important health co-benefits that need to be identified. For example, adaptation efforts focusing on urban design, such as increasing urban albedo through green roofs, increasing urban tree cover, reducing the size of the urban heat island through compact development, and decreasing impervious surface runoff through use of permeable paving surfaces have been shown to have multiple co-benefits.

By no means a comprehensive list, the strategies discussed above illustrate the diversity in mitigation and adaptation possibilities, and it should be noted that many new ideas and options are being developed. As with all emerging technologies, it is important to holistically examine their effects on health, both positive and negative, so that the best options for society can be identified and adopted.

Scope and Urgency. The necessary research on climate change health impacts, the health effects of mitigation, and development of appropriate adaptation strategies will not occur spontaneously and cannot occur in isolation. To be successful, an overarching research program needs to be integrated, focused, interdisciplinary, supported, and sustainable, yet flexible enough to adjust to new information and broad enough to cover the very diverse components described in this document. The effort must also be multinational, multiagency, and multidisciplinary, bringing together the strengths of all partners. The effort also must promote user-driven research that closely aligns future research directions with the needs of decision makers by facilitating multi-directional dialogue among information producers, providers, and end users. This research will require capacity building in a number of areas, especially in climate sciences and disease and ecosystem surveillance necessary to support the health sciences as they grapple with these issues. Finally, both the efforts and the outcomes need to be evaluated using clear metrics that are linked to assessment questions and outcome indicators to ensure they are valid, effective, and achieve the desired goals.

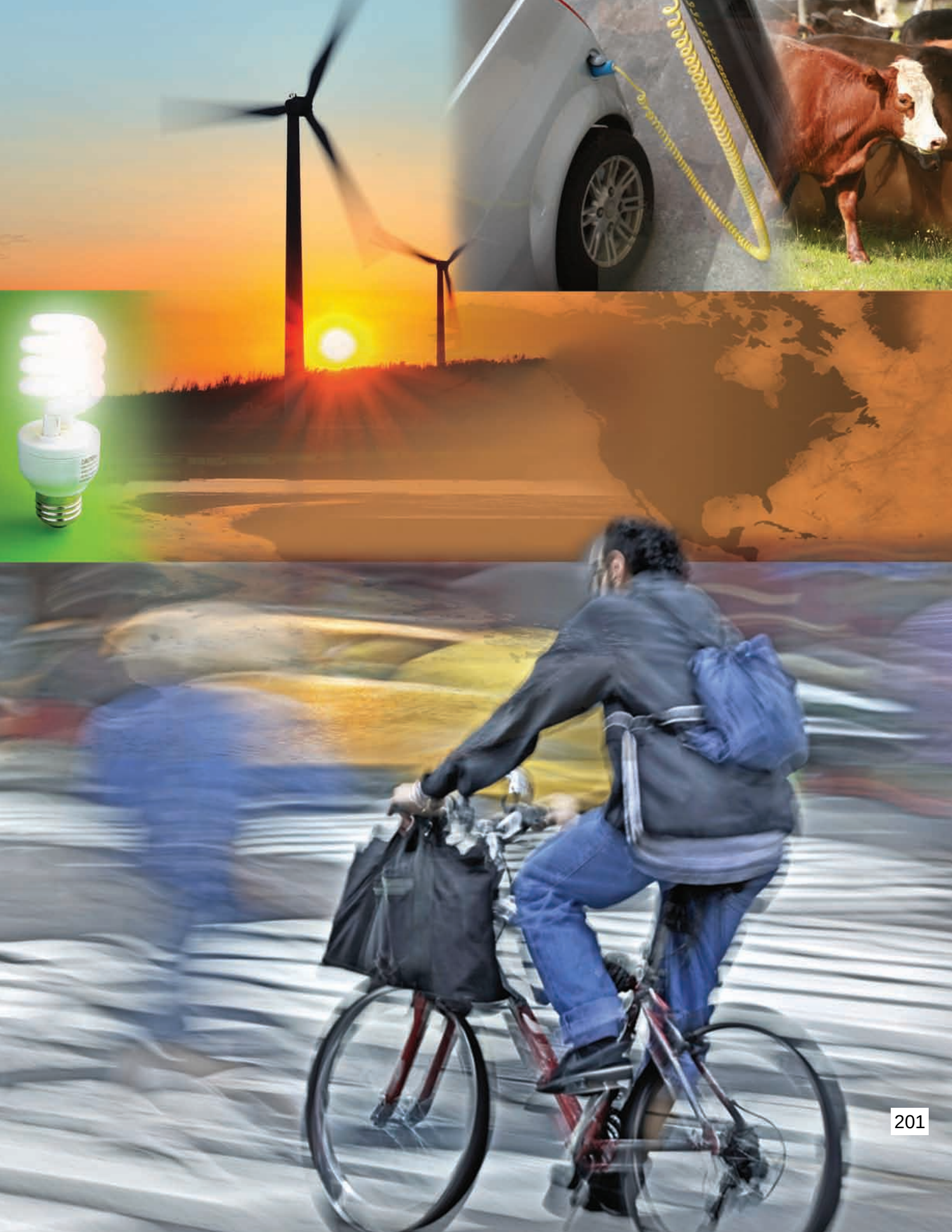
Natural systems adapt to environmental changes or they fail. Climate change threatens many of the natural and built systems that protect and preserve our nation's health. The infrastructure that we have put in place to protect health and provide well being in the United States is extremely diverse and includes hospitals, clinics, public health agencies, trained personnel, roads and transportation systems, the electrical grid, water treatment systems, and many other components. Threats to these systems from climate change range from damage to natural and built physical infrastructure to damage to intangible organizational structures (human and social capital) that are required to maintain resilience to environmental threats. Climate change could have grave impacts on public health systems if they are not appropriately strengthened. Research into the vulnerability of these systems will be critical to identifying areas most in need of attention, avoiding mistakes, limiting human suffering, and ultimately saving lives.

Summary Statement

Humans have successfully adapted to environmental change over time, from evolving natural physiological responses to the use of science, technology, and knowledge to improve our lives and advance our health. From the dawn of the industrial age, people have made great strides in improving health, and enjoy a markedly improved quality of life. However, these improvements have come at a cost that must now be understood and addressed. Climate change will force humans to negotiate with their changing environment as never before to find ways to reshape it both for short-term protection and long-term alleviation of health consequences.

There is no doubt that we have the capacity to find ways to avoid many of the worst health effects of climate change, and indeed, given the universality and potential magnitude of such effects, we have an ethical imperative to do so. The research needs described in this document should guide the process, helping us to develop the proper tools and make informed choices that will ultimately result in better health and better lives for the citizens of the United States and of the world.

*Interagency Working Group on
Climate Change and Health*



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Hyattsville City Council Agenda Item Report

Meeting Date: March 6, 2017

Submitted by: Joseph Solomon, W5

Submitting Department: Legislative

Item Type: Budget

Agenda Section: Discussion Items (8:50 p.m. - 9:40 p.m.)

SUBJECT

Hyattsville Senior Nutrition Program Partnership (15 minutes)

Motion

Discussion, Action TBD

Recommendation:

I move that the Mayor and Council authorize the City Administrator to negotiate and execute Memorandums of Understandings with College Park Meals on Wheels, Prince George's County Department of Family Services, and Prince George's Public Schools for the purposes of implementing a Senior Nutrition Program in the City. I further move that the Mayor and Council authorize FY18 funding for the program in an amount not to exceed \$25,000.

Sponsor(s):

Solomon

ATTACHMENTS

[Staff_Comments_on_Senior_Nutrition_Program_03-06-17.docx](#)

Summary Background:

In partnership with College Park Meals on Wheels, Prince George's County Department of Family Services' Nutrition Program, and Prince George's County Public Schools. The City of Hyattsville will offer a low-cost comprehensive senior meals program. The program will offer home delivered meal service for eligible seniors 3 days per week. Additionally, during the summer months of June, July, and August, the City of the Hyattsville will host 3 congregate site guest chef experiences at Felegy Elementary. Registration will be on a weekly first come, first served basis.

To be eligible for the Senior Nutrition Program, an individual must:

Be a City of Hyattsville resident

Be at least 60 years of age, or have a spouse that is 60 year of age and attends Senior Nutrition Program

The Prince George's County Senior Nutrition Program's mission is to promote the meal program, nutrition education, as well as social, recreational, and educational opportunities for older adults. The Senior Nutrition Program has two components: The Home-Delivered and Congregate Meal programs. Each meal served meets at least one-third of the Recommended Dietary Allowances for older adults and follows the Dietary Guidelines for Americans. The Home-Delivered Meal program provides meals to homebound older adults within the community, with the intent of assisting the resident with remaining in their own home. A hot meal is delivered to the older adult's door five days a week. The Congregate Meal program serves hot nutritious meals to seniors in a congregate setting such as senior centers, religious facilities, senior housing and community centers. Congregate program participants may be provided transportation to the local nutrition sites and eligible seniors are able to take part in the lunch program and have access to recreational and educational programs

Since 1974, College Park Meals on Wheels has been providing regular, healthy meals for seniors in the northern Prince George's County, Maryland area.

They rely on volunteers to pack and deliver meals for the cities of College Park, Greenbelt, Beltsville, Berwyn Heights and Adelphi.

For \$5.00 per day, we provide a hot lunch, dinner, and a breakfast meal for the next morning.

Please see additional background information: AARP Report 2015: Food Security Among Older Adults at this link: http://www.aarp.org/content/dam/aarp/aarp_foundation/2015-PDFs/AF-Food-Insecurity-2015Update-Final-Report.pdf

Next Steps:

Council discussion.

Fiscal Impact:

\$25,000.00

City Administrator Comments:

See attached staff comments

Community Engagement:

Initial council discussions in December 2016 and January 2017 council meetings.

Strategic Goals:

Goal 1: Availability of Information

Goal 4: Programming & Operations

Goal 5: Partnerships & Diversity

Legal Review Required?

N/A



Memo

To: Tracey Nicholson, City Administrator
From: Jake Rollow, Community Services Director
Date: March 6, 2017
Re: Senior Nutrition Program

This motion suggests two ways the City could participate in providing low-cost nutritious meals to seniors who live in the City of Hyattsville.

Partner Meals on Wheels College Park to provide home delivery in the City of Hyattsville

Meals on Wheels College Park is willing to deliver meals to seniors in the City of Hyattsville – they currently deliver them to nine residents. They offer numerous meal plans, the least expensive of which costs \$5 per day, for three days per week, and includes two cold meals and one hot meal per day.

Partner with Felegy Elementary to host congregate meals once per month during the summer

School facilities could be made available for this service, at a cost that PGCPs will not provide until a facility use application is submitted.

The County is willing to participate in such programming. They suggest hosting chef-prepared meals, which cost \$100, plus a \$4 “donation” per meal.

Costs to the City would also include transportation and staff time, but such events could be built into the senior services calendar and therefore not require funds in addition to current staffing/operation levels.

Main City Calendar: March 7 - 15, 2017

Weekly Program Offerings

Ageless Grace Senior Exercise Classes

Wednesdays, Thursdays and Fridays, 10:00 AM @ City Municipal Building

Creative Minds

Tuesdays and Thursdays, 10:00 AM @ Magruder Park Recreation Center

City Calendar: March 7 - 15, 2017

Call-A-Bus Trip to Shoppers & Price Rite

March 7, 2017, 11:00 AM - 1:00 PM

Bus pick up at Friendship Arms and by appointment for community residents (appointments must be made by 2:00 PM the day before).

Police & Public Safety Citizens' Advisory Committee Meeting

March 8, 2017, 7:30 PM - 8:30 PM @ City Municipal Building

Movin' With The Mayor: Yogalates

March 11, 2017, 11:00 AM - 12:00 PM @ Yoga Space Studio

Call-A-Bus Trip to Giant

March 13, 2017, 11:00 AM - 1:00 PM

Bus pick up at Friendship Arms and by appointment for community residents (appointments must be made by 2:00 PM the day before).

Senior Lunch/Lecture Series

March 15, 2017, 2:30 PM - 5:00 PM @ Laurel Regional Hospital

Call (301) 985-5058 to register today!

Code Compliance Advisory Committee

March 15, 2017, 7:00 PM @ Multipurpose Room

Public Hearing on the Proposed Budget

March 15, 2017, 7:30 PM - 8:00 PM @ 3rd Floor Council Chambers

Council Budget Work Session

March 15, 2017, 8:00 PM - 10:00 PM @ 3rd Floor Council Chambers