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National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling

THE AMOUNT AND FATE OF THE OIL[1]

Staff Working Paper No. 3

Staff working papers are written by the staff of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling for the use of members of the Commission. They do not necessarily reflect the views of the Commission or any of its members. In addition, they may be based in part on confidential interviews with government and non-government personnel.

The federal government's estimates of the amount of oil flowing into and later remaining in the Gulf of Mexico in the aftermath of the Macondo well explosion were the source of significant controversy, which undermined public confidence in the federal government's response to the spill. By initially underestimating the amount of oil flowing and then, at the end of the summer, appearing to underestimate the amount of oil remaining in the Gulf, the federal government created the impression that it was either not fully competent to handle the spill or not fully candid with the American people about the scope of the problem.

Loss of the public's trust during a disaster is not an incidental public relations problem. The absence of trust fuels public fears, and those fears in turn can cause major harm, whether because the public loses confidence in the federal government's assurances that beaches or seafood are safe, or because the government's lack of credibility makes it harder to build relationships with state and local officials, as well as community leaders, that are necessary for effective response actions.

This working paper first tells the story of the government's struggle to accurately estimate the rate of oil flow from the Macondo well. It next discusses the debate surrounding the government's report on the fate of the oil.[2] This paper aims to inform Commission findings regarding whether flow-rate estimates should have been more accurate from the outset, and whether the government presented information regarding the amount and fate of the oil to the public in an appropriate manner. Commission staff believe that recommendations aimed at improving the quality of information provided to the public are critical to improving public confidence, and thus to the success of future emergency responses.

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[1] Since this staff working paper was originally released in draft form on October 6, 2010, Commission staff have received comments on the paper from government agencies, non-government scientists, and industry; conducted additional interviews with government officials, non-government scientists, and industry representatives; reviewed more than 9,000 emails and documents produced by the National Oceanic and Atmospheric Administration (NOAA) pursuant to a FOIA request; examined new reports issued by the government and non-government scientists; and received additional information from BP. Staff have updated the paper to reflect the knowledge gained from these sources.

[2] DEEPWATER HORIZON MC252 GULF INCIDENT OIL BUDGET [hereinafter GULF INCIDENT OIL BUDGET] (Aug. 4, 2010), *available at* http://www.noaanews.noaa.gov/stories2010/PDFs/DeepwaterHorizonOilBudget20100801.pdf.

I. FLOW RATE: THE AMOUNT OF OIL RELEASED

When the blowout occurred on April 20, 2010, there were no established methods for accurately estimating the flow rate of an oil/gas mixture in deepwater.[3] This Part of the paper describes government and non-government efforts to accurately estimate the flow of oil from the Macondo well. It attempts to frame the questions of why initial government estimates were inaccurate, and whether the information conveyed to the public was different from operational estimates used by responders or other information known to the government. Section A charts flow-rate estimates created during the spill's first month. Section B discusses the question of which estimates—the low flow-rate estimates, or worst-case estimates—were the basis of government response operations. Section C considers whether the Flow Rate Technical Group, the government team assembled to address the gulf between official and independent flow-rate estimates, addressed the problem of failing public confidence due to inaccurate estimates. Finally, Section D compares the flow-rate estimates of non-government scientists generated since the well was capped with the government's current flow-rate figures.

A. The First Month

On the evening of April 20, the U.S. Coast Guard District Eight command center in New Orleans, Louisiana received a report of an explosion and fire aboard the mobile offshore drilling unit Deepwater Horizon.[4] On the morning of April 22, the Coast Guard informed the media that the rig was leaking oil at a rate of 8,000 barrels per day (bbls/day), and that responders were preparing for a leak of up to 700,000 gallons of diesel fuel (the total amount of fuel the rig could hold).[5] Later that morning, Deepwater Horizon sank, leaving a one mile by five mile sheen on the ocean's surface.[6]

How much oil was leaking into the Gulf of Mexico? For responders, politicians, and the public, the leaking well's "flow rate" quickly became a crucial and controversial question. Throughout the first month of the spill, government responders officially adhered to what we now know were low and inaccurate estimates. Independent scientists, on the other hand, used the small amount of publicly available flow data to generate estimates that have proven to be much more accurate. To make forward-looking recommendations, it is important to understand how this came to pass.

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[3] National Incident Command, Interagency Solutions Group Draft Document.
[4] Press Release, United States Coast Guard, Coast Guard Responding to Oil Drilling Platform Fire (Apr. 21, 2010), http://app.restorethegulf.gov/release/2010/04/22/coast-guard-responding-oil-drilling-platform-fire-0.
[5] *See* CNN Wire, *Coast Guard: Oil Rig That Exploded Has Sunk*, CNN (Apr. 22, 2010), http://news.blogs.cnn.com/2010/04/22/coast-guard-oil-rig-that-exploded-has-sunk/.
[6] *See* CNN Wire, *Oil Slick Spreads from Sunken Rig*, CNN (Apr. 22, 2010), http://www.cnn.com/2010/US/04/22/oil.rig.explosion/index.html.

1. The Government's Estimates

As a first step in determining whether, or how much, oil was flowing from the Macondo well, BP enlisted remotely operated vehicles (ROVs) to investigate the immediate wellhead area. These ROVs did not uncover any leaks.[7] Rear Admiral Mary Landry, the Federal On-Scene Coordinator (and ranking federal official on the spill response team at the time), told *CBS News* on April 23, that "at this time there is no crude emanating from that wellhead at the ocean floor . . . . there is not oil emanating from the riser either."[8]

But at the time of Admiral Landry's statement, the riser had not yet been inspected. Over the next 24 hours, BP's ROVs traced the riser from the wellhead to where the Deepwater Horizon rig had come to rest, approximately 1,500 feet from the blowout preventer (BOP). The ROVs discovered two leaks, one from a kink in the riser above the BOP ("kink leak") and a primary leak from the end of the riser, where it had broken off from the rig.[9]

After the discovery of these leaks, Coast Guard and BP officials put out an estimate on April 24: Up to 1,000 bbls/day were flowing from the two leaks in the riser.[10] Neither the Coast Guard nor BP divulged the data or methodology behind this estimate. The 1,000 bbls/day figure appears to have come from BP, although how it was calculated remains unclear.[11]

In the spill's second week, the official flow-rate estimate increased from 1,000 bbls/day to 5,000 bbls/day as a result of input from the National Oceanic and Atmospheric Administration (NOAA). On April 28, Admiral Landry stated that "NOAA experts believe the output could be *as much as* 5,000 barrels."[12] Although Admiral Landry did not provide further explanation, the media speculated that this latest estimate was derived through a method known as the "Bonn

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[7] Press Conference, Admiral Mary Landry and Doug Suttles, New Orleans, LA (Apr. 28, 2010), http://cgvi.uscg.mil/media/main.php?g2_itemId=843309.

[8] Television Interview of Mary Landry, *Coast Guard: Oil Not Leaking from Sunken Rig*, CBS NEWS (Apr. 23, 2010), http://www.cbsnews.com/video/watch/?id=6424647n.

[9] Press Conference, Admiral Mary Landry and Doug Suttles, New Orleans, LA (Apr. 28, 2010); Campbell Robertson, *Oil Leaking Underwater From Well in Rig Blast*, N.Y. TIMES (Apr. 24, 2010).

[10] *See, e.g.*, Press Release, Unified Command, Unified Command Continues to Respond to Deepwater Horizon (Apr. 25, 2010), http://app.restorethegulf.gov/release/2010/04/24/update-7-unified-command-continues-respond-deepwater-horizon; Robertson, *Oil Leaking Underwater From Well in Rig Blast*.

[11] Prior to the release of the 1,000 bbls/day figure, Admiral Landry's Scientific Support Coordinator, an official from the National Oceanic and Atmospheric Administration (NOAA), told her that the flow could be between 1,000 and 10,000 bbls/day, but that this range was highly uncertain. NOAA personnel conducting spill overflights generated this estimate. Interviews with government official. On April 29, NOAA Administrator Dr. Jane Lubchenco told reporters that, with "[t]he initial calculations, there was agreement among BP and NOAA scientists that the likely, approximate rate of flow was around 1,000 barrels a day." White House Press Briefing, Washington, D.C. (Apr. 29, 2010), http://www.whitehouse.gov/the-press-office/press-briefing-bp-oil-spill-gulf-coast. Nonetheless, Commission staff have been informed that BP, rather than NOAA, was the source actually relied upon for the 1,000 bbls/day figure. Interviews with government officials.

[12] Press Conference, Admiral Mary Landry and Doug Suttles, New Orleans, LA (Apr. 28, 2010) (emphasis added); Tim Dickinson, *The Spill, the Scandal, and the President*, ROLLING STONE (June 8, 2010).

Convention."[13] The method involves using aerial data to measure the extent of a spill, using color to estimate the thickness of various parts of the spill, and then calculating the volume.[14]

The source of the 5,000 bbls/day estimate was actually an unsolicited, one-page document emailed to Admiral Landry's Scientific Support Coordinator on April 26, by a NOAA scientist in Seattle.[15] The scientist also verbally noted to the Scientific Support Coordinator that the flow rate might be upwards of 10,000 bbls/day.[16] The Scientific Support Coordinator then informed Unified Command that the flow rate was "at least 5,000 [bbls/day] or more."[17]

The NOAA scientist derived the "estimated present volume release rate" of 5,000 bbls/day from video data, interpreted by both NOAA and BP personnel, of the speed at which oil was leaking from the end of the riser.[18] He also used a method based on satellite imagery, similar to the Bonn Convention, to estimate that 10,000 barrels of oil were on the ocean's surface; this finding supported the 5,000 bbls/day figure.[19] (He noted, however, that estimating surface volume from the visual appearance of an oil slick was "a highly unreliable process."[20])

The NOAA scientist's 5,000 bbls/day estimate did not take into account the kink leak, and his methodology for estimating the velocity of the leaking oil was imprecise.[21] Further, there is no indication that the BP and NOAA personnel upon whose visual observations the scientist relied had any expertise in estimating deep-sea flow velocity from video data, or that they used an established or peer-reviewed methodology when doing so. This is not a criticism of the scientist, who made clear his assumptions and that the 5,000 bbls/day figure was a "very rough estimate[]."[22] His stated intent in disseminating the estimate was to warn government officials that the flow rate was multiple times greater than 1,000 bbls/day.[23] As he described it,

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[13] *See, e.g.*, Joel Achenbach, *How Big is the Gulf Spill, Really?*, SEATTLE TIMES (May 13, 2010); Justin Gillis, *Size of Spill Is Underestimated, Scientists Say*, N.Y. TIMES (May 13, 2010).
[14] NOAA, OFFICE OF RESPONSE AND RESTORATION, OPEN WATER OIL IDENTIFICATION JOB AID FOR AERIAL OBSERVATION (Nov. 2007), http://response.restoration.noaa.gov/book_shelf/1462_FINAL%20OWJA%202007.pdf.
[15] NOAA Document.
[16] Internal NOAA email.
[17] Interview with government official.
[18] NOAA Document; Internal NOAA email; NOAA, MASS BALANCE EXPLANATIONS (May 12, 2010). The scientist generated this number by assuming that the flow came from a hole with a diameter of 40 centimeters, at a velocity of 15 cm/sec, and that 50% of the total flow was oil (as opposed to gas and other material).
[19] NOAA Document. The scientist assumed that at least half of the oil released evaporated or dispersed in the water column before reaching the surface. Using that assumption, the surface-volume estimate confirmed a flow-rate estimate of 5,000 bbls/day. E.g., if the oil first began leaking on April 22, one could then take the 10,000 barrel figure, double it to account for evaporation and dispersion, and then divide by 4 days to arrive at 5,000 bbls/day, though the one-page document did not take these steps.
[20] NOAA Document; *see also* Interview with government official.
[21] NOAA Document. For example, the document notes that the velocity could be "between 7 cm/sec and 30 cm/sec" and then, without explanation, uses 15 cm/sec when generating the 5,000 bbls/day estimate (using 30 cm/sec, the flow rate would be over 10,000 bbls/day).
[22] Internal NOAA email.
[23] Interview with government official.

the "[o]riginal calculation of 5000 bbl/day leak rate was designed simply as a working number to ascertain the level of response effort."[24]

Despite the acknowledged inaccuracies of the NOAA scientist's estimate, and despite the existence of other and potentially better methodologies for visually assessing flow rate (discussed below), 5,000 bbls/day was to remain the government's official flow-rate estimate for a full month, until May 27.[25]

2. Non-Government Estimates

From the outset, estimates from non-government sources were significantly higher than official government estimates. In at least some instances, the cause of the discrepancy appears to be that non-government scientists relied on more refined or better-established methodologies.

a. Estimates Based on Surface Expression

Between April 27 and April 30, BP generated its own internal flow-rate figures using overflight data.[26] BP estimated the areas of the Gulf's surface covered in an oily "sheen," "dull oil," and "dark oil."[27] Then, approximating the thickness of oil in each of these three categories, BP calculated a low, high, and "best guess" flow rate, factoring in evaporation, skimming, and chemical dispersion. The company's flow-rate estimate ranged from approximately 1,000 bbls/day up to 14,000 bbls/day, with its "best guess" falling between 5,000 and 6,000 bbls/day.[28] On May 17, BP used a similar method to generate an estimate that was consistent with its prior figures.[29] According to government officials, the 1,000 to 14,000 bbls/day range would serve as BP's operational flow-rate estimate through late May.[30] On May 24, however, BP produced a document to Congress that demonstrated the company had used an undisclosed method to generate much higher figures. In that document, BP estimated that the "[e]xpected range of possible flow rates is 5,000 to 40,000 [bbls/day]," the "[m]aximum theoretical flow rate is

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[24] Email from NOAA to the White House (May 17, 2010). On the day following the release of the 5,000 bbls/day estimate, President Obama made his first public statement about the spill and the Coast Guard designated it a Spill of National Significance, paving the way for the appointment of Admiral Thad Allen as National Incident Commander. *BP Oil Spill Timeline*, GUARDIAN (July 22, 2010), http://www.guardian.co.uk/environment/2010/jun/29/bp-oil-spill-timeline-deepwater-horizon; Campbell Robertson, *White House Takes a Bigger Role in the Oil Spill Cleanup*, N.Y. TIMES (Apr. 29, 2010); 40 C.F.R. § 300.323.

[25] *See* Press Release, Unified Command, Flow Rate Group Provides Preliminary Best Estimate of Oil Flowing from BP Oil Well (May 27, 2010), http://app.restorethegulf.gov/release/2010/05/27/flow-rate-group-provides-preliminary-best-estimate-oil-flowing-bp-oil-well.

[26] Confidential BP Document.

[27] *Id.*; *see also* BP Flow-Rate Document, *available at* http://globalwarming.house.gov/files/SHARE/BPOilSpill/BPDocument1.pdf.

[28] Confidential BP Document; *see also* BP Flow-Rate Document; Honorable Edward J. Markey, letter to the Commission (Sept. 28, 2010), *available at* http://globalwarming.house.gov/mediacenter/pressreleases_2008?id=0322#main_content.

[29] Confidential BP Document.

[30] Interview with government official; *see also* Interview with Doug Suttles, Houston, TX (Oct. 13, 2010).

60,000 [bbls/day]," and, if the BOP and wellhead were removed, "the rate could be as high as ~ 100,000 [bbls/day] . . . ."[31]

The first independent flow-rate estimate surfaced on April 27, when the official government estimate was still 1,000 bbls/day. Using publicly available satellite images, John Amos, the founder of SkyTruth.org, estimated the leak size to be at least five times the government estimate—5,000 to 20,000 bbls/day.[32] Amos generated the low number in his range by multiplying the surface area of the spill by what he considered the minimum thickness for oil to be visible on the Gulf's surface (1 micron). He then generated the high number by relying on a BP statement that 3% of the slick was significantly thicker (100 microns). Amos's estimate was conservative (i.e., low) in assuming that none of the oil had burned with the rig, been collected by response crews, evaporated, dispersed, or was then below the surface.[33] Within days, Amos's estimate appeared in the national press.[34]

On May 1, Dr. Ian MacDonald (a Florida State University oceanographer) published a new estimate on SkyTruth.org. Based on a Coast Guard map that tracked the spill's surface size and classified the color of the surface oil throughout, Dr. MacDonald generated a flow estimate of 26,500 bbls/day using the Bonn Convention.[35] Like Amos, he assumed that none of the oil had burned, evaporated, dispersed, been skimmed, or was then below the surface.[36]

Both independent scientists estimated the spill's volume from the visual appearance of the surface slick—the same general method used by the NOAA scientist who generated the 10,000 barrel surface-volume estimate. Experts note that such methods are not reliable for estimating the volume of large spills, due in part to the difficulty of accurately determining oil

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[31] BP WORST CASE SCENARIO DOCUMENT, *available at* http://globalwarming.house.gov/files/WEB/flowrateBP.pdf; Honorable Edward J. Markey, letter to the Commission (Sept. 28, 2010); Bryan Walsh, *The Worse Case Scenario Gets Worse for BP as New Documents Come to Light*, TIME (June 21, 2010), http://ecocentric.blogs.time.com/2010/06/21/the-worse-case-scenario-gets-worse-for-bp-as-new-documents-come-to-light/.

[32] *See* John Amos, *Gulf Oil Spill Rate Must Be Much Higher Than Stated—6 Million Gallons So Far?*, SKYTRUTH.ORG (Apr. 27, 2010), http://blog.skytruth.org/2010/04/gulf-oil-spill-rate-must-be-much-higher.html; John Amos, *Gulf Oil Spill—Bigger Than Exxon Valdez*, SKYTRUTH.ORG (Apr. 28, 2010), http://blog.skytruth.org/2010/04/gulf-oil-spill-bigger-than-exxon-valdez.html.

[33] *Id.* Amos assumed that all oil leaking from the well reached the surface to be observed. If that were not the case, the estimated flow rate would be higher.

[34] Ian Talley, *Experts: Oil May Be Leaking at Rate of 25,000 Barrels a Day in Gulf*, WALL ST. J. (Apr. 30, 2010); *see also* Emily Gertz, *Gulf Oil Spill Far Worse Than Officials, BP Admit, Says Independent Analyst*, ONE EARTH BLOG (Apr. 29, 2010), http://www.onearth.org/node/2084.

[35] John Amos, *Gulf Oil Spill—New Spill Calculation—Exxon Valdez Surpassed Today*, SKYTRUTH.ORG (May 1, 2010), http://blog.skytruth.org/2010/05/gulf-oil-spill-new-spill-rate.html. The NOAA scientist who calculated the 5,000 bbls/day estimate said that he was not aware of any Coast Guard maps that "showed slick size and classified the color of the surface oil," and suggested that Dr. MacDonald may have used "daily forecast maps" that "are totally unsuitable to estimate surface thickness using either the Bonn agreement or [American Society for Testing and Materials] standards." Email from NOAA Scientist to Commission Staff (Oct. 7, 2010).

[36] Amos, *Gulf Oil Spill—New Spill Calculation—Exxon Valdez Surpassed Today*.

thickness from aerial data.[37] Dr. MacDonald, however, did at least use an established protocol—the Bonn Convention—for determining surface oil thickness. Similarly, Amos explained the basis for his minimum and maximum assumptions regarding thickness. By contrast, the NOAA methodology was undisclosed at the time. A NOAA document reviewed by Commission staff indicates that its scientist's surface-volume estimate was based on an assumption that 99% of the spill was 0.1 microns thick, while the remainder was 100 microns thick.[38] The NOAA scientist told Commission staff that he obtained these figures by asking responders doing overflights what percentage of the spill appeared as "sheen" (99%) and what percentage appeared as "dark oil" (1%).[39] To date, the government has not publicly released an explanation of the assumptions underlying its 5,000 bbls/day estimate.

b. Estimates Based on Video of the Flow

On May 12, BP released a 30-second video of oil coming out of the end of the broken riser—a crucial piece of data. As discussed above, the government's estimate of 5,000 bbls/day appears to have been based on visual observation of flow from the riser. Within 24 hours, at least three scientists had used various methodologies to derive estimates of the flow rate substantially greater than the government's then-current estimate.[40]

- **Dr. Timothy Crone**, a marine geophysicist at Columbia University's Lamont-Doherty Earth Observatory, estimated that 50,000 to 100,000 bbls/day of total flux were flowing out of the end of the riser.[41] To determine the velocity of the flow, Dr. Crone used a technique called Optical Plume Velocimetry, which involves temporal cross-correlation of the visual intensity of two pixels in a video (both in the plume, one downstream from the other). He developed this technique in a 2008 peer-reviewed paper relating to flow rates.[42]

- **Dr. Eugene Chiang**, an astrophysicist at the University of California at Berkeley, estimated the total flux from the end of the riser to be between 20,000 and 100,000 bbls/day.[43] Dr. Chiang is an expert in orders-of-magnitude estimation (i.e., estimating size or scale from small amounts of data). He estimated the velocity of oil coming out of

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[37] Achenbach, *How big is Gulf Spill, Really?*; Gillis, *Size of Oil Spill Underestimated, Scientists Say*; NOAA Paper, *Visual Observations and the Bonn Agreement*.
[38] NOAA Document.
[39] Email from NOAA Scientist to Commission Staff (Oct. 7, 2010). This calculation also relied upon an American Society for Testing and Materials standard for determining the thickness of "sheen" (0.1 microns) and "dark oil" (100 microns). Interview with government official.
[40] Richard Harris, *Gulf Spill May Far Exceed Official Estimates*, NATIONAL PUBLIC RADIO (May 14, 2010), http://www.npr.org/templates/story/story.php?storyId=126809525.
[41] *Id.*; Raymond Gellner, *BP Oil Spill Rate in Gulf May Be 3 Million Gallons Per Day*, WORLD NEWS EXAMINER (May 14, 2010); Telephone Interviews with Dr. Timothy Crone, Lamont-Doherty Earth Observatory (Aug. 18, 2010 and Sept. 3, 2010). Dr. Crone noted that his early estimates could not be more precise because of the low quality and short duration of the video.
[42] Crone, McDuff, & Wilcock, *Optical Plume Velocimetry: A New Flow Measurement Technique for Use in Seafloor Hydrothermal Systems*, EXPERIMENTS IN FLUIDS, vol. 45, no. 4, at 899-915 (2008).
[43] Harris, *Gulf Spill May Far Exceed Official Estimates*.

the riser based on the angle of flow and the rate at which oil would naturally rise through sea water. He used this information to estimate the diameter of the riser, which generated the high end of his range; he based the low-end number on information that the plume could be emanating from a smaller pipe within the riser.[44]

- **Dr. Steven Wereley**, a mechanical engineer at Purdue University and expert in fluid mechanics, estimated that the total flux from the end of the riser was 72,179 bbls/day (±20%).[45] To arrive at this estimate, Dr. Wereley used a method called Particle Image Velocimetry, which uses a computer program to identify and track distinct "flow structures" in the plume exiting the riser (akin to the billows of a cloud). The method analyzes how fast structures move across the screen in terms of pixels, and then factors in scale and volume to determine flow rate.[46] Dr. Wereley co-authored a 2007 book on this flow-rate estimation method.[47]

All of these non-government figures estimated the total flux being released from the end of the riser, which includes both oil and natural gas.[48] If we were to assume the then-current understanding that the flux was 50% oil, the Crone, Chiang, and Wereley estimates would be, respectively: 25,000-50,000 bbls/day; 10,000-50,000 bbls/day; and 36,090 bbls/day. The Crone, Chiang, and Wereley estimates did not include flow from the kink leak, for which there was then no public data.

Despite having made its own, similar estimates, BP attempted to dismiss the work of Crone, Chiang, and Wereley. A company spokesman told *National Public Radio* on May 13, that "there's no way to estimate the flow coming out of the pipe accurately."[49] Five days later, BP released the first video of the kink leak and an initial estimate that the flux was about 50% oil. Testifying before Congress the next day, Dr. Wereley estimated that the kink leak was producing a flow of roughly 25,000 bbls/day (±20%) of total flux. Adding that figure to his

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[44] *Id*.; Telephone Interview with Dr. Eugene Chiang, University of California at Berkeley (Aug. 13, 2010).
[45] Harris, *Gulf Spill May Far Exceed Official Estimates*; *Sizing up the BP Oil Spill: Science and Engineering Measuring Methods*, Briefing Before the Subcomm. on Energy and Environment of the H. Comm. on Energy and Commerce, 111th Cong. (May 19, 2010) (testimony of Dr. Steven Wereley).
[46] *Id.*
[47] RAFFEL, WILLERT, WERELEY, & KOMPENHANS, PARTICLE IMAGE VELOCIMETRY: A PRACTICAL GUIDE (2d ed. 2007).
[48] Telephone Interview with Dr. Chiang (Aug. 13, 2010); Telephone Interview with Dr. Crone (Aug. 18, 2010); Telephone Interview with Dr. Steven Wereley, Purdue University (Aug. 12, 2010). While estimates of the oil-to-gas ratio in the flux varied over the course of the spill, scientists from Woods Hole Oceanographic Institution took measurements at the source to accurately determine the ratio. Those scientists originally concluded that the flux was 43.7% oil. They have since revised this figure down to 42.8% oil.
[49] MORNING EDITION, *Transcript: Gulf Spill May Far Exceed Official Estimates*, NATIONAL PUBLIC RADIO (May 14, 2010), http://www.npr.org/templates/transcript/transcript.php?storyId=126809525; *see also* Suzanne Goldenberg, *Marine Scientists Study Ocean-Floor Film of Deepwater oil leak*, GUARDIAN (May 13, 2010), http://www.guardian.co.uk/business/2010/may/13/bp-oil-spill-ocean-footage.

previous estimate of flow from the end of the riser (72,179 bbls/day of flux), he arrived at a total flow rate of approximately 50,000 bbls/day of oil.[50]

The Crone, Chiang, and Wereley estimates (and at least some of BP's internal estimates) proved to be significantly more accurate than the initial official estimates. The government's 5,000 bbls/day figure, derived from the same type of visual observation as the Crone, Chiang, and Wereley estimates, appears to have been based on a cruder methodology than at least Crone's and Wereley's. It is possible that official flow estimates during the spill's first month would have been more accurate if the government had either enlisted greater in-house scientific expertise, or enlisted outside scientific expertise by making available the data on which government estimates were based. The government appears to have taken an overly casual approach to the calculation and release of the 5,000 bbls/day estimate—which, as the only official estimate for most of May, took on great importance.

Suggestions for the Commission's Consideration:

- The Commission may wish to recommend adoption of policies or procedures to ensure that, in a spill response, the federal government dedicates appropriate scientific expertise to initial spill volume estimates, to the extent that it wishes to release such estimates.

- The Commission may wish to recommend that, where possible without compromising confidentiality or operations, the federal government disclose the methodology and/or data on which its spill volume estimates are based either to the public or to outside scientific experts. Such information would allow outside scientists to generate estimates or to offer informed criticism of the government's work, helping to refine and to increase public confidence in official estimates.

B. The Impact on Operations

Government responders have repeatedly insisted to Commission staff that low initial flow-rate estimates did *not* impact the response. Responders have uniformly maintained—and, indeed, publicly stated during the response itself—that they scaled their efforts to the "worst-case" spill scenario rather than to official flow-rate estimates. It may, however, have been better practice for the government to disclose the estimates that actually drove Unified Command plans—that is, the *operational* worst-case discharge figures—rather than disclosing only the official estimates they deemed not relevant to the clean-up.

Because the worst-case figures that emerged within days of the spill, although imprecise, ended up being roughly equivalent to the actual flow rate (as later determined by the government), we cannot conclude that inaccurate official estimates adversely impacted clean-up operations. National Incident Commander Admiral Thad Allen, however, has stated that early

[50] *Sizing up the BP Oil Spill: Science and Engineering Measuring Methods*, Briefing Before the Subcomm. on Energy and Environment (May 19, 2010) (testimony of Dr. Steven Wereley).

dispersant decisions were based on the 5,000 barrels per day figure, and that the higher government estimates released later in the spill "spurred responders to consider reassessing the strategy for the use of dispersants as well as other oil recovery methods."[51] In addition, other work by the Commission and its staff indicates that the early underestimation of the flow rate impeded planning for and analysis of source-control efforts like the cofferdam and especially the top kill.

Soon after the spill began, frontline Coast Guard personnel requested worst-case discharge information from the Minerals Management Service and BP, both of which reported a figure of 162,000 bbls/day (the worst-case estimate from BP's original drilling permit).[52] A high-level official, however, told Commission staff that the Coast Guard did not believe the figure from the drilling plan was a credible worst-case estimate.[53] On April 23, the Coast Guard and NOAA received an updated estimate of 64,000-110,000 bbls/day, which appeared in both an internal Coast Guard Situation Report and on a dry-erase board in the NOAA Seattle war room.[54] By early May, BP had lowered its internal worst-case estimate to 60,000 bbls/day.[55] BP officials disclosed a similar estimate to Congress on May 4, stating during a briefing that the "maximum estimated flow would be 60,000 barrels a day, with a mid-range estimate of 40,000 barrels a day,"[56] figures virtually identical to the estimates in the BP document produced to Congress in late May.[57]

Front-line responders may therefore have based their decision-making on estimates roughly reflecting the magnitude of the spill. But despite the fact that the Unified Command had this information, says it relied on it for operations, and publicly stated that it was operating under a worst-case scenario, the government never disclosed what its *operational* scenario was. As a confidential NOAA report drafted on April 28 noted: "There is no official change in the volume being released but the [Coast Guard] is no longer stating that the release rate is 1,000 barrels a day. Instead they are saying that they are preparing for a worst-case release and bringing all assets to bear."[58] Responders stuck to this blueprint, stating that, while 1,000 or 5,000 bbls/day

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[51] Admiral Thad Allen, letter to Honorable Edward J. Markey, 12 (Oct. 1, 2010).
[52] Interviews with Coast Guard officials; INITIAL EXPLORATION PLAN, MISSISSIPPI CANYON BLOCK 252, 7-1 (Mar. 10, 2009), *available at* http://www.gomr.boemre.gov/PI/PDFImages/PLANS/29/29977.pdf.
[53] Interview with Coast Guard official.
[54] U.S. COAST GUARD, DISTRICT EIGHT SITUATION REPORT 18 (April 23, 2010), *available at* http://s3.documentcloud.org/documents/3176/uscg-logs.pdf; Ben Raines, *Video Shows Federal Officials Knew Quickly of Potential for Massive Oil Flow in Gulf Spill*, MOBILE PRESS-REGISTER (May 1, 2010), http://blog.al.com/live/2010/05/video_shows_federal_officials.html; Dickinson, *The Spill, the Scandal, and the President*. The refined worst-case figure apparently came from either the Minerals Management Service or BP, though its origin and the methodology underlying it have not been established. Interviews with government officials.
[55] Interviews with government officials.
[56] Press Release, Markey: New Flow Rate Shockingly Close to BP's Initial "Worst Case" Scenario (Aug. 2, 2010), http://markey.house.gov/index.php?option=com_content&task=view&id=4076&Itemid=141.
[57] *See supra* text accompanying note 31.
[58] Ben Raines, *Leaked Report: Government Fears Deepwater Horizon Well Could Become Unchecked Gusher*, MOBILE PRESS-REGISTER (Apr. 30, 2010), http://blog.al.com/live/2010/04/deepwater_horizon_secret_memo.html.

were the official best flow-rate estimates, the government was scaling the response to an unquantified worst-case scenario.[59]

The only instance in which government officials publicly quantified a worst-case scenario was during a May 2 interview of Admiral Allen and Secretary of the Interior Ken Salazar on *CNN*. Secretary Salazar stated: "The worst-case scenario is we could have 100,000 barrels or more of oil flowing out." Admiral Allen clarified: "Well, if we lost the total wellhead, it could be 100,000 barrels or more a day."[60] This worst-case flow-rate figure was for a theoretical possibility that never occurred—total loss of the wellhead. It was not a worst-case estimate of the amount of oil actually flowing from the well. Further, it does not appear to have been the government's *operational* worst-case estimate, because the more extreme event that Secretary Salazar and Admiral Allen were discussing did not happen.[61]

The decision to withhold worst-case discharge figures may have been made above the operational level. It is the understanding of the Commission staff that the possibility of releasing the worst-case discharge figures was at least discussed at Unified Command.[62] The Commission staff have also been advised that, in late April or early May 2010, NOAA wanted to make public some of its long-term, worst-case oil trajectory models, which were based upon flow rates of up to 50,000 bbls/day, and requested approval to do so from the White House's Office of Management and Budget.[63] The Office of Management and Budget did not grant NOAA's request.[64]

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[59] *See, e.g.*, Press Briefing, Admiral Thad Allen (May 1, 2010), http://www.marinelog.com/DOCS/NEWSMMIX/2010may00010.html ("At the outset, when we realized that the unit had sunk, we made preparations to stage equipment for a worst-case scenario. The deployment of our equipment was not related to any of the early estimates related to 1,000 barrels a day or 5,000 barrels a day . . . ."); Press Briefing, Admiral Mary Landry (May 14, 2010), http://app.restorethegulf.gov/release/2010/05/19/transcript-press-briefing-may-14-2010 ("Whether the flow is one, five, 10, or 15 thousand barrels per day, the mobilization of resources has been to prepare for a worst-case scenario. Our resources and tactics are not constrained by flow estimates—I have to emphasize that."); Press Briefing, NOAA Administrator Jane Lubchenco (May 20, 2010), http://app.restorethegulf.gov/release/2010/05/24/teleconference-lubchenco-may-20 ("5,000 was always understood to be a very rough estimate. That number was useful and sort of the best estimate at the time. . . . The response to the spill has never been pegged to that estimate of [5,000 bbls/day] or any other estimate. We've always pegged our response to the worst-case scenario and had much more significant effort than would have been required had it only been five.").

[60] Interview with Secretary Salazar and Admiral Allen, CNN (May 2, 2010), http://edition.cnn.com/TRANSCRIPTS/1005/02/sotu.02.html.

[61] The 100,000 bbls/day figure may have been generated by BP. As noted above, in late May, BP turned over a document to congressional investigators stating that, if the BOP and wellhead were removed, "the rate could be as high as ~ 100,000 barrels per day . . . ." BP WORST CASE SCENARIO DOCUMENT; Honorable Edward J. Markey, letter to the Commission (Sept. 28, 2010); Walsh, *The Worse Case Scenario Gets Worse for BP as New Documents Come to Light*.

[62] Interviews with government officials.

[63] Interviews with government officials; *see also* NOAA Administrator Jane Lubchenco, letter to the Commission (Oct. 7, 2010). The version of the model released on July 2 prominently noted that it used "a release rate of 33,000 barrels/day," confirming that NOAA's long-term trajectory models were based on an assumed or estimated flow rate. NOAA MODELS LONG-TERM OIL THREAT TO GULF AND EAST COAST SHORELINE (July 2, 2010), http://www.noaanews.noaa.gov/stories2010/20100702_longterm.html.

[64] Interviews with government officials.

According to the Office of Management and Budget, it delayed rather than prevented the release of NOAA's worst-case model to "ensure the analysis reflected the best known information at the time and accurately reflected the limitation of the model and available information, including response actions."[65] Indeed, two months later, on July 2, NOAA did release a long-term, worst-case oil trajectory model.[66] But the July model differed from the original model. It relied upon a flow-rate estimate that was not available until mid-June and accounted for collection of oil at the wellhead through the Top Hat, which did not begin until early June. Because of the delay, the government did not release an operational worst-case flow-rate estimate until two weeks before the well was capped on July 15.

The Commission may wish to consider recommendations that encourage government responders to disclose information about the scenarios under which they are operating—in this case, the operational worst-case discharge estimates. Putting aside the question of whether the public had a right to know the worst-case discharge figures, disclosure of those estimates, and explanation of their role in guiding the government effort, may have improved public confidence in the response. Instead, government officials attempted to assure the public that they were not basing operations on the official flow-rate estimates, while not stating what they were basing operations on instead. That lack of information may have contributed to public skepticism about whether the government appreciated the size of the Deepwater Horizon spill and was truly bringing all of its resources to bear. Moreover, the national response may have benefited early on from a greater sense of urgency, which public discussion of worst-case discharge figures may have generated.

Suggestions for the Commission's Consideration:

- The Commission may wish to consider recommendations that encourage government responders to scale operations to a credible worst-case scenario and to disclose information about their operational scenarios. Such a recommendation would be consistent with current Coast Guard policy, which directs responders not to "lose sight of the importance of accurate and timely spill volume quantification based on maximum potential volume during initial response actions."[67]

C. The Flow Rate Technical Group

Although responders stated that accurate flow-rate estimates were not important to their clean-up efforts, the Unified Command eventually felt a need to assert leadership on the issue,

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[65] Press Release, Office of Management and Budget and NOAA, Statement by OMB Acting Director Jeffrey Zients and NOAA Administrator Jane Lubchenco (Oct. 6, 2010).
[66] NOAA MODELS LONG-TERM OIL THREAT TO GULF AND EAST COAST SHORELINE (July 2, 2010).
[67] *See* Coast Guard "ALCOAST" Bulletin, Subject: Coast Guard Marine Environmental Response Doctrine—Incident Specific Preparedness Review (ISPR) Update (Jan. 12, 2009), http://www.uscg.mil/announcements/alcoast/ALCOAST02209.txt.

possibly as a result of media attention and public criticism of the low early numbers.[68] On May 19, the National Incident Command created an interagency Flow Rate Technical Group (Flow Rate Group) and charged it with generating (1) a preliminary flow rate as soon as possible and (2) a final flow-rate estimate based on peer-reviewed methodologies within two months.[69] On May 23, upon the recommendation of Secretary Salazar, Dr. Marcia McNutt, Director of the U.S. Geological Survey and Science Advisor to the Secretary of the Interior, was appointed the Group's leader.[70]

The Flow Rate Group was originally comprised of three sub-groups, made up of both government and non-government scientists: (1) the Plume Modeling Team, which used the Particle Image Velocimetry method to estimate flow velocity from video of the leaks; (2) the Mass Balance Team, which estimated spill size from aerial images taken by NASA's AVARIS aircraft; and (3) a team that analyzed the flow captured by the Riser Insertion Tube Tool to establish a baseline flow rate.

The Flow Rate Group enlisted non-government scientists with applicable expertise and experience, including Dr. Wereley, a critic of the low early estimates. The Group's initial figures, however, proved low, too. It did not release an arguably accurate estimate until mid-June. (This estimate was also the first to incorporate measurements by a team led by Secretary of Energy Steven Chu.)

The Flow Rate Group's early estimates relied primarily on work by the Plume Team. The Riser Insertion Tube Tool method was not supposed to produce an accurate figure; rather, it aimed to provide "a basic calculation of the lower limit of possible oil that is spilling."[71] The mass balance approach was hampered by the depth of the wellhead (roughly 5,000 feet below sea level) and the difficulty of accounting for the rate of natural dispersion as the plume rose to the surface. In addition, because the Macondo well was located in the subsea Mississippi Canyon, some released oil never reached the surface and was deposited in the canyon's seafloor sediment. These factors complicated mass balance flow-rate estimates because a significant amount of the oil released never reached the surface.[72]

According to members of the Plume Team, it struggled to produce an accurate estimate because it lacked suitable video data from BP.[73] The Team required long clips of high-quality video of the leaks, filmed from certain angles.[74] BP had to task an ROV specifically to collect

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[68] Interview with government official.
[69] Coast Guard Document; Press Release, Deepwater Horizon Incident Joint Information Center, The Ongoing Administration-Wide Response to the Deepwater BP Oil Spill (May 21, 2010), http://www.restorethegulf.gov/release/2010/05/21/ongoing-administration-wide-response-deepwater-bp-oil-spill.
[70] Coast Guard Document; Interview with government official.
[71] Press Release, Deepwater Horizon Incident Joint Information Center, Flow Rate Group Provides Preliminary Best Estimate of Oil Flowing From BP Oil Well (May 27, 2010), http://app.restorethegulf.gov/release/2010/05/27/flow-rate-group-provides-preliminary-best-estimate-oil-flowing-bp-oil-well.
[72] Interview with government official; National Incident Command, Interagency Solutions Group Draft Document.
[73] Interviews with government official; Interview with non-government sources.
[74] *Id.*; Interview with non-government sources.

this data. Because generating flow-rate estimates was not a priority and BP was focused on other source-control operations, ROVs did not record the necessary video until early June, after BP had attempted the top kill (May 26-28) and cut the riser from the top of the BOP (June 2-3).[75] Until the Plume Team received the high-quality video on June 8, it had to estimate flow from segments of video recorded by ROVs while they were performing other tasks.[76] If BP and the government had prioritized the collection of suitable data, the Plume Team might have been able to generate a more accurate flow-rate figure by late May.

1. May 27, 2010 Estimate (12,000-25,000 bbls/day)

The Flow Rate Group published its first estimate on May 27, noting that "[t]he only range of flow rates that is consistent with all 3 of the methods considered by the [the Group] is 12,000 to 19,000 barrels per day. Higher flow rates [of up to 25,000 bbls/day] are consistent with the data considered by [the Plume Team]."[77] The Group's press release contained little information as to how each of the three Flow Rate Group teams calculated those ranges, other than to note that the Plume Team's range of 12,000-25,000 bbls/day was "an initial lower bound estimate."[78]

On June 2, the Flow Rate Group released a three page *Summary Preliminary Report* that explained the May 27 estimate in more detail.[79] That document noted that the Plume Team produced "a range of lower bounds" of 12,000 to 25,000 bbls/day (±40%), but did not elaborate on the underlying data or calculations.[80] Moreover, the June 2 report did not include the upper ranges of the Plume Team's estimates.[81] It is the Commission staff's understanding that the "lower bound" range was simply a collection of the minimum estimates produced by each of the Plume Team members. A few members had also produced maximum estimates, several of which were in excess of 50,000 bbls/day, but this upper bound was not released.[82]

The Plume Team did not release an upper range at this time because "[t]he experts concluded that the effect of the unknown unknowns made it more difficult to produce a reliable upper bound on the flow rate."[83] As of May 27, the Team had not yet received the high-quality video they needed. Because of concerns that that BP could have selected data that showed only low-flow conditions, the Team did not believe it appropriate to generate a maximum flow-rate

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[75] Interview with government official; *see also* Interview with non-government sources.
[76] Interview with government official; Interview with non-government sources
[77] Press Release, Deepwater Horizon Incident Joint Information Center, Flow Rate Group Provides Preliminary Best Estimate of Oil Flowing From BP Oil Well (May 27, 2010).
[78] *Id.*
[79] MARCIA MCNUTT, SUMMARY PRELIMINARY REPORT FROM THE FLOW RATE TECHNICAL GROUP (June 2, 2010), *available at* http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=33972.
[80] *Id.*
[81] *Id.* The Plume Team did draft a 43-page interim report elaborating on its calculations, but the report was not included with the May 27 or June 2 press releases and does not appear to have been publicized. *See* INTERIM REPORT TO THE FLOW RATE TECHNICAL GROUP: ESTIMATED LEAK RATES AND LOST OIL FROM THE DEEPWATER HORIZON SPILL (May 27, 2010), *available at* http://s3.amazonaws.com/nytdocs/docs/367/367.pdf.
[82] Interview with non-government source.
[83] MCNUTT, SUMMARY PRELIMINARY REPORT FROM THE FLOW RATE TECHNICAL GROUP.

estimate.[84] Members of the Team also based their May 27 estimates upon an assumption that only 25% of the total flux emitted from the well was oil (data acquired thereafter demonstrated that this figure was far too low).[85]

2. June 10, 2010 Estimate (20,000-40,000 bbls/day)

On June 10, the Flow Rate Group announced a revised flow-rate estimate of 25,000 to 30,000 bbls/day with a lower bound of 20,000 and a higher bound of 40,000 bbls/day.[86] The Group produced a three page document called *Pooling Expert Assessments* to accompany those estimates. That document provided intervals with high and low numbers from each of six members of the Plume Team, but only after a "statistical procedure" was applied to "reconcile" the different members' full ranges.[87] The Plume Team's new estimate benefited from additional low-quality video, as well as an updated assumption—which would prove quite accurate—that 41% of the total flux was oil. Members of the Team generated this new figure by comparing the amount of oil the *Discoverer Enterprise* (a ship on the surface) was collecting through the Riser Insertion Tube Tool with the amount of gas the ship was processing and flaring.[88]

The June 10 press release also noted an estimate by researchers with Woods Hole Oceanographic Institution, led by Dr. Richard Camilli, who were conducting their work outside of the auspices of the Flow Rate Group but in coordination with Unified Command. On May 31, these researchers had used an ROV mounted with sonar and acoustic sensors to determine the volume and velocity of the outflow from the end of the riser and kink leak. Their initial rough estimate was a flow rate for total flux (oil plus gas) of between 65,213 and 124,991 bbls/day (0.12 to 0.23 cubic meters/second).[89] Along with the Flow Rate Group's press release, the

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[84] Interviews with government official; Interview with non-government sources.

[85] Interview with non-government sources. At the time, the 25% figure was the Team's assumption of the percentage of oil within the hydrocarbon mixture as it exited the riser on the sea floor. Because oil expands as it rises, oil is a smaller percentage of an oil/gas mixture in the deep sea than at the surface. Later flow-rate estimates accounted for this expansion and used an oil/gas ratio based on the percentage of oil in the mixture if it were at sea level. Had the Plume Team initially done this, its May 27 estimate would have been higher. Email from NOAA Scientist to Commission Staff (Jan. 4, 2011); Interview with government official; Interview with non-government sources.

[86] Press Release, Deepwater Horizon Incident Joint Information Center, Admiral Allen; Dr. McNutt Provide Updates on Progress of Scientific Teams Analyzing Flow Rates From BP's Well (June 10, 2010), http://app.restorethegulf.gov/release/2010/06/10/admiral-allen-dr-mcnutt-provide-updates-progress-scientific-teams-analyzing-flow-.

[87] ANTONIO POSSOLO AND PEDRO ESPINA, POOLING EXPERT ASSESSMENTS (June 8, 2010), *available at* http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=34800. On the same day, the Plume Team issued a statement reiterating the limitations of its earlier estimate: "On May 27, the Team issued an Interim Report that established an estimated range for the minimum possible spillage rate but did not issue an estimate for a possible maximum value because the quality and length of the video data could not support a reliable calculation." BILL LEHR, STATEMENT OF THE PLUME TEAM OF THE FLOW RATE TECHNICAL GROUP (June 10, 2010), *available at* http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=34638.

[88] Interview with non-government sources.

[89] Press Release, Deepwater Horizon Incident Joint Information Center, Admiral Allen; Dr. McNutt Provide Updates on Progress of Scientific Teams Analyzing Flow Rates From BP's Well (June 10, 2010). Commission staff converted the Woods Hole team's estimate from cubic meters per second to barrels per day.

government released a brief one-page statement by the Woods Hole team explaining the methodology behind its estimate.[90] Yet, seemingly because this estimate was given in cubic meters/second rather than bbls/day, it did not attract media attention.

Finally, the June 10 press release announced that two new teams had been added to the Flow Rate Group: the Reservoir Modeling Team, which would help determine the rate at which oil flowed from the reservoir into the well, and the Nodal Analysis Team, which would use that information to determine the rate at which the oil traveled through the well and into the Gulf.[91] These two teams did not contribute to the June 10 or June 15 estimates. The time required for the government to finalize contracts and non-disclosure agreements with the Reservoir Team, which was comprised of non-government scientists, delayed their work. This, in turn, slowed the Nodal Team, whose work relied upon reservoir models.[92]

3. June 15, 2010 Estimate (35,000-60,000 bbls/day)

On June 15, the Flow Rate Group announced that it had generated a new official flow estimate of 35,000 to 60,000 bbls/day in conjunction with Secretary Chu and Secretary Salazar.[93] According to the accompanying press release, the new estimate was "based on a combination of analyses of high resolution videos taken by ROVs, acoustic technologies, and measurements of oil collected by the oil production ship together with pressure measurements inside the top hat."[94] No additional information on methodology was provided.

We now know that the high end of this estimate was derived from pressure readings from a sensor that Secretary Chu's team had BP place in the Top Hat above the blowout preventer on June 13.[95] These sensor readings, along with data on the amount of oil being captured by the Top Hat and an estimate of the percentage of oil still escaping into the Gulf, allowed Secretary Chu's team to generate a flow-rate range of 72,700 to 83,000 bbls/day.[96]

The lower end of the June 15 estimate came from the Plume Team. As noted above, on June 8, the Team finally received high-quality video of the leaking plume, recorded after BP

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[90] RICHARD CAMILLI, PRELIMINARY REPORT FROM THE WOODS HOLE OCEANOGRAPHIC INSTITUTION FLOW RATE MEASUREMENT GROUP (June 10, 2010), *available at* http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=34799.

[91] Press Release, Deepwater Horizon Incident Joint Information Center, Admiral Allen; Dr. McNutt Provide Updates on Progress of Scientific Teams Analyzing Flow Rates From BP's Well (June 10, 2010).

[92] Interviews with government official.

[93] Press Release, Deepwater Horizon Incident Joint Information Center, U.S. Scientific Team Draws on New Data, Multiple Scientific Methodologies to Reach Updated Estimate of Oil Flows from BP's Well (June 15, 2010), http://app.restorethegulf.gov/release/2010/06/15/us-scientific-team-draws-new-data-multiple-scientific-methodologies-reach-updated.

[94] *Id.* "Top Hat" was the nickname for the loose-fitting cap placed over the top of the blowout preventer, which collected up to approximately 15,000 bbl/day from the Macondo well between June 3 and July 10, 2010.

[95] Interviews with government officials; *see also* Henry Fountain, *BP Provides Plan to Speed Up Siphoning*, N.Y. TIMES (June 14, 2010).

[96] Interviews with government officials; Department of Energy Document. As discussed in other work by the Commission and its staff, there is some doubt as to the accuracy of pressure readings taken from inside the Top Hat.

removed the riser (thereby creating only one leak point, at the top of the BOP).[97] On June 13, the Plume Team met at NOAA's offices in Seattle.[98] Using the new video data, it generated a range of 25,000 to 50,000 bbls/day, with a best estimate of 35,000 to 45,000 bbls/day.[99]

On June 14, 2010, Secretary Chu and his team, Secretary Salazar, and members of the Flow Rate Group held a conference call.[100] On the call, Secretary Chu's team and the Plume Team debated the validity of their respective estimates. Neither side was entirely convinced by the other, so they compromised: The next day, they jointly announced a new official flow-rate estimate of 35,000 to 60,000 bbls/day.[101]

4. The Current Estimate (52,700-62,200 bbls/day)

The June 15 estimate was finally updated on August 2. A press release announced that, at the outset of the spill, the flow rate was 62,000 bbls/day (±10%), but that it had declined to 53,000 bbls/day (±10%) just before the well was capped on July 14.[102] Another document released on August 4, the *Deepwater Horizon MC252 Gulf Incident Oil Budget* (*Gulf Incident Oil Budget*), provides some additional details. It notes that the "[g]overnment estimate of discharge ranged from 62,200 bbl[/day] on April 22, 2010 to 52,700 bbl[/day] on July 14, 2010."[103]

We now understand that Secretary Chu's team calculated the 52,700 bbls/day figure by taking pressure readings on July 14, using a sensor inside the capping stack that eventually stopped the flow of oil entirely. Before all of the valves on the stack had been closed, the sole channel for flow was an opening in the capping stack's kill line. Pressure readings from inside that line, along with some other data points, allowed the government to generate a flow-rate estimate with an uncertainty of plus or minus 10%.[104]

Once the capping stack was closed on July 15, the pressure from the reservoir was about 2,000 psi lower than anticipated, indicating that the reservoir had been depleted over the course of the spill. Using this information, and modeling backwards, Secretary Chu's team and the Flow Rate Group together arrived at an estimate of 62,200 bbls/day for the first day of the

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[97] Interview with non-government sources.
[98] *Id.*
[99] National Incident Command, Interagency Solutions Group Draft Document; Plume Team, Flow Rate Technical Group, DEEPWATER HORIZON RELEASE ESTIMATE OF RATE BY PIV 3 (July 21, 2010), http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=68011. On July 21, the Plume Team issued a peer-reviewed final report supporting their June 13 flow-rate estimate. *Id.*
[100] NOAA Document.
[101] Press Release, Deepwater Horizon Incident Joint Information Center, U.S. Scientific Team Draws on New Data, Multiple Scientific Methodologies to Reach Updated Estimate of Oil Flows from BP's Well (June 15, 2010).
[102] Press Release, Deepwater Horizon Incident Joint Information Center, U.S. Scientific Teams Refine Estimates of Oil Flow from BP's Well Prior to Capping (Aug. 2, 2010), http://app.restorethegulf.gov/release/2010/08/02/us-scientific-teams-refine-estimates-oil-flow-bps-well-prior-capping.
[103] GULF INCIDENT OIL BUDGET at 1.
[104] Interview with government official.

spill.[105] Given the new figures, the *Gulf Incident Oil Budget* concluded that the total amount of oil discharged during the spill was 4,928,100 barrels (± 10%, which gives a range of 4,435,290 to 5,420,910 total barrels), a number not reduced by the amount of oil captured at the wellhead (827,046 barrels).[106]

The Flow Rate Group is presently compiling more information on the flow rate and total amount of oil discharged, with the intention of generating a peer-reviewed report.[107] Release of this paper will allow for a better assessment of the Group's work and value. It is worth noting now, however, that, based on the government's current figures, the Flow Rate Group did not succeed in releasing an accurate high-end estimate until mid-June.

Suggestions for the Commission's Consideration:

- Although its initial estimates were inaccurate, and contractual issues resulted in non-government scientists starting to contribute more slowly than they otherwise could have, the Flow Rate Group may be a valuable model for integration of outside scientific expertise. The Commission may wish to recommend new protocols or procedures that require the responsible party to provide the government with all data necessary to rapidly and accurately estimate flow rate or spill volume.

D. Final Government Estimate Versus Estimates of Independent Scientists

The flow-rate estimates of independent scientists, generated since the well was capped, are useful in assessing the accuracy and durability of the government's current figures.

In a peer-reviewed paper published on September 23, 2010, Dr. Timothy Crone and Dr. Maya Tolstoy of Columbia University's Lamont-Doherty Earth Observatory describe their total estimate of the flow from the Macondo well. Using the Optical Plume Velocimetry method referenced above, they conclude that, from April 22, until the riser was cut on June 3, the flow rate was 55,900 bbls/day (±21%); and that between June 3 and July 15, when the well was capped, the flow was 67,500 bbls/day (± 19%).[108] Crone and Tolstoy estimate the total release to be 5,174,887 barrels (± 20%).[109] Their calculations assume that oil represents 40% of the total flux from the well and do not include oil that was released from the kink leak prior to the riser cut on June 3.[110] If the kink leak were taken into account, this estimate would be on the high end of the government's current estimate for the total release.

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[105] Interviews with government officials.
[106] GULF INCIDENT OIL BUDGET at 1.
[107] It is Commission staff's understanding that the Group will issue a final report in January 2011.
[108] Timothy J. Crone, et al., *Magnitude of the 2010 Gulf of Mexico Oil Leak*, SCIENCE EXPRESS, at 1 (Sept. 23, 2010); Telephone Interviews with Dr. Crone (Aug. 18, 2010 and Sept. 3, 2010).
[109] *Id.*
[110] *Id.*

The Woods Hole team also generated an estimate for the total flow from the well. BP first contacted scientists at Woods Hole on May 1, requesting that they undertake diagnostic work on the BOP and measure the flow rate. Woods Hole developed a plan to use ROV-mounted acoustic and sonar technology to determine flow velocity and volume, but BP cancelled that project on May 6, citing a need to focus on the containment dome effort.[111] On May 31, with the aid of the Coast Guard, Woods Hole was finally able to launch its ROV and take readings from the end of the broken riser and kink leak.[112]

Following the Flow Rate Group's press release on June 10, the Woods Hole team refined its data and factored in the assumption that oil accounted for 43.7% of the total flux.[113] With this new assumption, the team concluded that, on May 31, the riser was leaking oil at 40,700 bbls/day and the kink was leaking at 18,500 bbls/day, for a total oil flow of 59,200 bbls/day.[114] Using that figure and the 53,000 bbls/day estimate for July 14 generated by Secretary Chu's team, the Woods Hole team calculated the declining flow rate over time, from April 22 to July 14. The team estimated a total release of approximately five million barrels during the course of the spill.[115] In the aftermath of the spill, Dr. McNutt stated that, if a similar blowout occurs in the future, the government will be able to quickly and reliably estimate the flow rate using the Woods Hole team's methods, which she believes succeeded in providing an accurate estimate of the flow from the Macondo well.[116]

The emerging consensus among government and independent scientists is that roughly five million barrels of oil were released by the Macondo well, with over four million barrels pouring into the waters of the Gulf of Mexico. Using different methods, these different groups of scientists arrived at the same approximate figure.

BP, however, disputes these estimates.[117] While it has not released its own figures, BP has suggested that the government's estimate of the total amount of oil released from the

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[111] *Sizing up the BP Oil Spill: Science and Engineering Measuring Methods*, Briefing Before the Subcomm. on Energy and Environment of the H. Comm. on Energy and Commerce, 111th Cong. (May 19, 2010) (testimony of Dr. Richard Camilli). The containment dome, or cofferdam, was a large steel box designed to be placed over the leak at the end of the riser where it would channel hydrocarbons to a ship on the surface. It did not succeed in collecting oil and gas.

[112] RICHARD CAMILLI, PRELIMINARY REPORT FROM THE WHOI FLOW RATE MEASUREMENT GROUP; Interview with Dr. Richard Camilli and Dr. Christopher Reddy, Woods Hole Oceanographic Institution, Washington, D.C. (Aug. 19, 2010); Telephone interview with Dr. Camilli. (Sept. 10, 2010).

[113] Telephone Interview with Dr. Camilli. (Sept. 10, 2010). The Woods Hole team has recently revised this figure downward to 42.8%.

[114] *Id.*

[115] *Id*. The Woods Hole team's revised oil-to-gas ratio alters their May 31 flow rate estimate, reducing it to roughly 58,000 bbls/day. This change will also slightly reduce their total release figure of 5 million barrels. Email from Woods Hole to Commission Staff (Dec. 6, 2010).

[116] Transcript, Deepwater Blowout Containment Conference (Sept. 22, 2010), http://www.doi.gov/news/video/Deepwater-Blowout-Containment-Conference.cfm; *see also* Interview with government official.

[117] BP has a strong financial incentive to challenge the government's final flow-rate estimate. Under the Clean Water Act, BP can be fined up to $37,500 per day for unpermitted discharges of oil, or up to $1,100 per barrel of oil.

Macondo well—4.9 million barrels—is overstated by 20 to 50%.[118] According to BP: "[T]he August 2 [government estimate] and other similar estimates . . . rely on incomplete or inaccurate information, rest in large part on assumptions that have not been validated, and are subject to far greater uncertainties than have been acknowledged."[119] BP's basic argument against the government's final estimate is that it fails to take into account "significant flow impediments," such as objects in the BOP, that would have eroded over the course of the spill. BP therefore asserts that the government is incorrect in concluding that the flow rate *decreased* over time from 62,200 bbls/day in the first days of the spill down to 52,700 bbls/day just before the well was capped. In BP's view, the flow rate likely *increased* over time, reaching a maximum just before the capping.[120] BP also contends that the government's 52,700 bbls/day estimate for the last day of the spill is itself too high.[121]

Suggestions for the Commission's Consideration:

- The Commission may wish to recommend the technology and/or methods used by the Woods Hole team as a best practice going forward, if flow rate has to be determined rapidly in the absence of accurate pressure readings.

II. THE FATE OF THE OIL RELEASED

The second Part of this staff working paper describes the background to, and controversy surrounding, the "fate of the oil" released into the Gulf of Mexico during the Deepwater Horizon spill. On August 4, 2010, the government released an Oil Budget providing figures for the amounts of oil captured at the wellhead, burned, skimmed, evaporated or dissolved, chemically dispersed, and naturally dispersed. An important question for the Commission is whether that document or associated statements by administration officials created a misleading impression that the fate of the oil was clear, and that a large majority of the oil was "gone." (The government released an updated version of the Oil Budget report on November 23, altering some of the figures and emphasizing that the report did not "indicate where the oil is now."[122])

Section A briefly describes the background to the August 4 Oil Budget and its rollout by the Obama administration. Section B outlines the Oil Budget's limitations, which may have been obscured in that rollout. Section C discusses the reaction to the Oil Budget, as well as the nature of the November 23 updates. Finally, Section D summarizes ongoing scientific research related to the fate of the oil, which suggests that whether spilled oil in the Gulf of Mexico is gone or still lingering below the surface remains unclear.

If BP's discharges are found to be the result of gross negligence or willful misconduct, it will be fined not less than $140,000, and not more than $4,300 per barrel of oil. 33 U.S.C. § 1321(b)(7); 40 C.F.R. § 19.4.

[118] Meeting with BP, Washington, D.C. (Oct. 22, 2010).

[119] BP'S PRELIMINARY RESPONSE TO THE FLOW RATE AND VOLUME ESTIMATES CONTAINED IN STAFF WORKING PAPER NO. 3 (Oct. 21, 2010).

[120] *Id*. at 4-5.

[121] *Id*. at 3-4.

[122] Press Release, NOAA, *Federal Interagency Group Issues Peer-Reviewed 'Oil Budget' Technical Documentation* (Nov. 23, 2010), http://www.noaanews.noaa.gov/stories2010/20101123_oilbudget.html.

A. Overview of the Oil Budget

1. History of the Budget Tool

The Oil Budget began as an operational tool that helped responders target their efforts and assess the effectiveness of skimming, burning, dispersants, and other response techniques. In the days immediately following the sinking of the Deepwater Horizon, the Coast Guard relied on a simple Microsoft Excel spreadsheet to evaluate the ongoing success of the response.[123] As the complexity and scale of the Deepwater Horizon spill became apparent, however, Coast Guard leadership needed a more advanced tracking tool to monitor the discharged oil.[124] On June 11, the National Incident Command requested the creation of a tool with the ability to document the efficacy of all skimming, burning, source capture, and dispersant application activities.[125] Experts from NOAA, the National Institute of Standards and Technology, and the U. S. Geological Survey formed the Oil Budget Calculator Science and Engineering Team (Oil Budget Team) to develop the tool, which relied upon flow-rate data from the Flow Rate Group.[126]

The Oil Budget Team's tool was ready for use by June 22.[127] From that point on, Coast Guard personnel would enter daily data on dispersant applied, oily water skimmed, and oil burned. The budget tool produced reports detailing the daily and cumulative results of the response efforts, as well as the volume of oil that remained to be dispersed or cleaned up.[128]

2. Fate of the Oil Estimates

On August 4, the federal government released a five-page report titled *BP Deepwater Horizon Oil Budget: What Happened to the Oil?* (*What Happened to the Oil*),[129] as well as a ten-page supporting document, the *Gulf Incident Oil Budget*[130] (collectively, the Oil Budget). The Oil Budget provided the first public estimate of the amount of oil discharged over the course of the spill (April 22 to July 14), a total of 4,928,100 barrels (±10%, which gives a range of

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[123] Jane Lubchenco, et al., BP DEEPWATER HORIZON OIL BUDGET: WHAT HAPPENED TO THE OIL? 5 [hereinafter WHAT HAPPENED TO THE OIL?] (Aug. 4, 2010), *available at* http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf; U.S. Geological Survey Document.

[124] U.S. Geological Survey Document.

[125] Interview with government officials.

[126] U.S. Geological Survey Document; Interview with government officials; *Oil Budget Q&A 8.4.10*, U.S. GEOLOGICAL SURVEY 1, http://www.usgs.gov/foia/budget/08-04-2010...FW-%20FINAL%20Tps%20and%20Q&A%20on%20%20Oil%20Budget.pdf.

[127] Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team ("Oil Budget Team"), OIL BUDGET CALCULATOR TECHNICAL DOCUMENTATION 1 (Nov. 23, 2010).

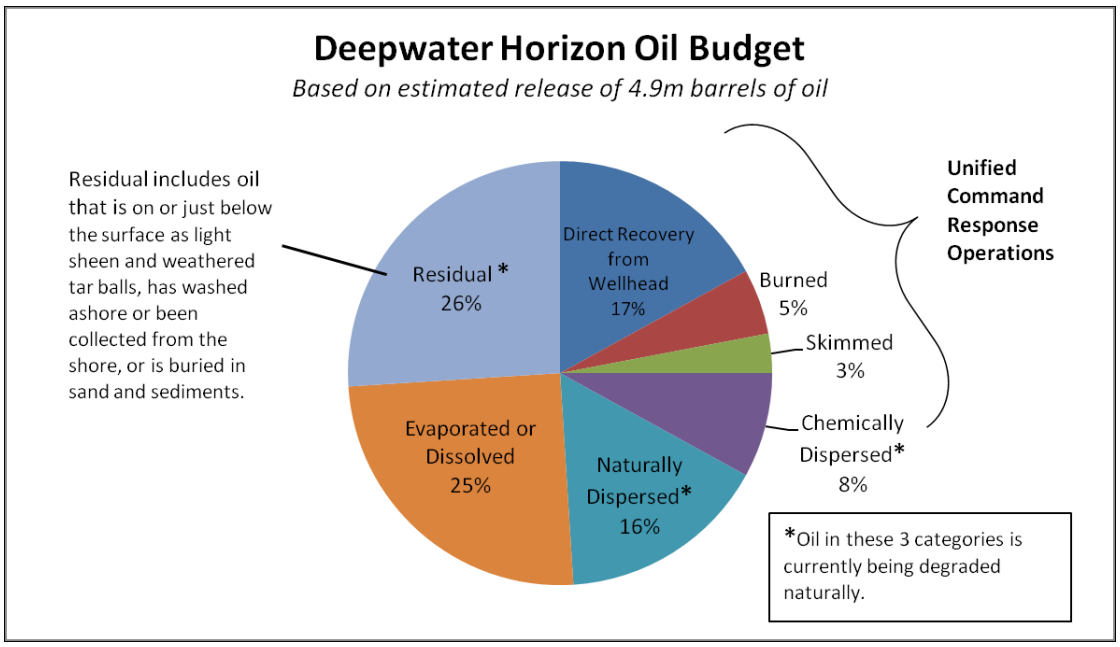
[128] U.S. Geological Survey Document.

[129] WHAT HAPPENED TO THE OIL?

[130] GULF INCIDENT OIL BUDGET.

4,435,290 to 5,420,910 total barrels). The documents also provided an assessment of the fate of the spilled oil, as depicted in Figure 1 below:

Figure 1



The Oil Budget accounted for 100% of the oil from the Macondo well through the following seven categories:

1. **Direct Recovery from Wellhead** (17%): Calculated by aggregating the amount of oil siphoned from the source through methods such as the Riser Insertion Tube Tool and Top Hat.

2. **Burned** (5%): Calculated using the American Society for Testing Materials burn rate standards, with differing rates for non-emulsified and emulsified oil.

3. **Skimmed** (3%): Calculated by multiplying the total amount of oily water collected by a fraction corresponding to the estimated average oil content of the mixture.

4. **Chemically Dispersed** (8%): Calculated based on the amount of chemical dispersants applied at the source and on the surface. ("Dispersed" oil is defined as oil droplets smaller than 100 microns.) The calculation assumes an oil-to-dispersant ratio of 20:1, based on an international standard. The subsea application of dispersants is, however, believed to be more efficient, possibly resulting in a ratio of 50:1 to 75:1.[131] In its later,

[131] *See, e.g.*, Letter from Doug Suttles, Chief Operating Officer for Exploration and Production, BP, to Rear Admiral James Watson, Federal On-Scene Coordinator (July 11, 2010), *available at*

peer-reviewed report, the Oil Budget Team doubled this figure, estimating that 16% of the oil was chemically dispersed.[132]

5. **Naturally Dispersed** (16%): Calculated by taking the total amount of oil, subtracting the estimate for subsurface chemical dispersion, and then multiplying the remainder by an estimated factor for "natural dispersion," which represents the process by which some oil coming out of the riser at high speed is sprayed off into small droplets.

6. **Evaporated or Dissolved** (25%): Calculated by applying an evaporation rate for Louisiana sweet crude oil to the amount of oil estimated to have reached the surface and not to have been burned. The calculation accounted for dissolution, and applied a higher evaporation rate to oil released within the past 24 hours than to older oil.[133]

7. **Residual** (26%): The remainder once all oil accounted for in the other categories is subtracted from the total amount released from the well. Also described in the government reports as oil "remaining."[134] The Oil Budget Team contemplated using the label "other" for this category, but decided against doing so.[135] *What Happened to the Oil* notes that the residual category "includes oil still on or just below the surface in the form of light sheen or tar balls, oil that has washed ashore or been collected from the shore, and some that is buried in sand and sediments and may resurface through time."[136]

3. The Rollout of the Budget

In late July, the White House decided to publicly release the Oil Budget and asked NOAA to take the lead on drafting the short report to introduce the tool.[137] The Budget cleared the interagency review process in time for its August 4 release.[138] The unveiling of the Oil Budget coincided with Admiral Allen's announcement that the "static kill" effort had succeeded. On the morning of August 4, the Director of the White House Office of Energy and Climate

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http://www.scribd.com/doc/34931289/2010-07-06-Suttles-Watson; Katie Peek, *How Do Oil Dispersants Work?*, POPSCI (May 28, 2010), http://www.popsci.com/science/article/2010-05/how-do-oil-dispersants-work.

[132] Oil Budget Team, OIL BUDGET CALCULATOR TECHNICAL DOCUMENTATION (Nov. 23, 2010).

[133] Interview with government official; *see also* Justin Gillis, *U.S. Finds Most Oil From Spill Poses Little Additional Risk*, N.Y. TIMES (Aug. 4, 2010).

[134] GULF INCIDENT OIL BUDGET.

[135] Interview with government officials.

[136] WHAT HAPPENED TO THE OIL? at 2.

[137] Email from Heather Zichal to Jane Lubchenco (July 29, 2010).

[138] During the review process, the Environmental Protection Agency (EPA) expressed concerns about the pie chart's potential to obscure the uncertainty of the government's estimates. Email from Lisa Jackson to Jane Lubchenco (July 31, 2010). For example, EPA recommended that NOAA combine chemically and naturally dispersed oil into a single category because there was not enough information to accurately distinguish between the two mechanisms. Email from Bob Perciasepe to Jane Lubchenco, et al. (July 31, 2010); Email from Bob Perciasepe to Stephen Hammond, et al. (Aug. 1, 2010). NOAA disagreed. Administrator Lubchenco asserted that combining the two categories would not decrease any uncertainty and that "'[c]hemically dispersed' is part of the federal response and 'naturally dispersed' is not, and there is interest in being able to sum up the federal response efforts." Email from Jane Lubchenco to Bob Perciasepe, et al. (Aug. 1, 2010).

Change Policy, Carol Browner, appeared on *ABC*, *CBS*, *CNN*, *NBC*, *MSNBC*, and *Fox News* morning shows to discuss the success of the static kill effort and the conclusions of the Oil Budget Team.[139]

Ms. Browner did not describe the Oil Budget as an operational tool designed to assist responders. Instead, some of her statements presented the Budget as a scientific assessment of how much of the oil was "gone":

- "I think it's also important to note that our scientists have done an initial assessment, and more than three-quarters of the oil is gone. The vast majority of the oil is gone."[140]

- "The good news is that the vast majority of the oil appears to be gone. . . . The scientists are telling us about 25 percent was not captured or evaporated or taken care of by mother nature."[141]

- "[W]hat the scientists are telling us today is that . . . almost three quarters of the oil was actually captured, cleaned, and skimmed."[142]

- "[T]he vast majority of the oil is gone. . . . Dispersants played a small role, they weren't the only reason why almost 75% of the oil has been contained and is gone."[143]

Subsequent headlines on August 4 reflected these characterizations: "75 percent of spilled Gulf oil gone, White House says."[144] The Oil Budget Team's findings, however, did not

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[139] *See, e.g.*, David Jackson, *Obama Aide on Gulf Spill: 'No Oil is Leaking'*, USA TODAY (Aug. 4, 2010), http://content.usatoday.com/communities/theoval/post/2010/08/obama-aide-on-gulf-no-oil-is-leaking/1. Subsequent news media reports raised questions about this timing, including the possibility that political pressures within the White House might have prompted a premature release. *See* Dan Froomkin, *Questions Mount About White House's Overly Rosy Report On Oil Spill*, HUFFINGTON POST (Aug. 20, 2010), http://www.huffingtonpost.com/2010/08/20/overly-rosy-report-on-oil_n_688142.html.

[140] Television Interview of Carol Browner, TODAY SHOW, NBC NEWS (Aug. 4, 2010), http://www.youtube.com/watch?v=To-fGPNyUdw; Robert Farley, *Carol Browner Says Three-Quarters of the Oil Spilled in the Gulf is Gone*, ST. PETERSBURG TIMES (Aug. 16, 2010), http://www.politifact.com/truth-o-meter/statements/2010/aug/16/carol-browner/carol-browner-says-three-quarters-oil-spilled-gulf/.

[141] Television Interview of Carol Browner, *White House: Turning Point in Oil Containment*, ABC NEWS (Aug. 4, 2010), http://abcnews.go.com/GMA/video/white-house-turning-point-oil-containment-11320458; AFP, *75 Percent Oil From Gulf of Mexico Spill is Gone: Official*, GOOGLE NEWS (Aug. 4, 2010), http://www.google.com/hostednews/afp/article/ALeqM5h1qkjFdSvSOH6qmoXacsi4EtgmjQ.

[142] Television Interview of Carol Browner, CBS NEWS (Aug. 4, 2010), http://www.youtube.com/watch?v=lyutuErxPo8&feature=related.

[143] Television Interview of Carol Browner, MSNBC (Aug. 4, 2010), http://content.usatoday.com/communities/theoval/post/2010/08/obama-aide-on-gulf-no-oil-is-leaking/1.

[144] The Associated Press, *Oil Well Plugged with Mud, BP Says; 75 Percent Spilled Gulf Oil Gone, White House Says*, TIMES-PICAYUNE (Aug. 4, 2010), http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/08/oil_well_plugged_with_mud_bp_s.html; *see also, e.g.*, Jim Polson & Allison Bennett, '*Vast Majority' of Oil Gone From Gulf, Browner Says*, BLOOMBERG (Aug. 4, 2010); Farley, *Carol Browner Says Three-*

support the claim that 75% of the oil was "gone." The 75% not in the "remaining" category included "dissolved" and "dispersed" oil, which was potentially being biodegraded, but was not "gone."

By 9:00 a.m. on August 4, NOAA Administrator Dr. Jane Lubchenco emailed Ms. Browner's deputy and other officials to express her concern "that the oil budget is being portrayed as saying that 75% of the oil is gone": "It's not accurate to say that 75% of the oil is gone. 50% of it is gone—either evaporated or burned, skimmed or recovered from the wellhead." Administrator Lubchenco asked the officials to "help make sure" the error was corrected.[145] She had made the same point to the White House before the Budget rollout; a July 30 email to Ms. Browner's deputy had emphasized that Administrator Lubchenco opposed grouping dispersed oil with recovered oil because the former was "still out there or [was] being degraded."[146]

The Oil Budget rollout continued on the afternoon of August 4 with a White House press briefing attended by Ms. Browner, White House Press Secretary Robert Gibbs, Admiral Allen, and Administrator Lubchenco. At the briefing, the speakers again discussed the success of the static kill and the findings of the Oil Budget Team. Administrator Lubchenco described the Budget's findings in somewhat different and more conservative terms than Ms. Browner, stating that "at least 50 percent"—not 75%—"of the oil that was released is now completely gone from the system."[147]

In addition, Ms. Browner and Administrator Lubchenco emphasized that the report was "peer-review[ed]" by federal and non-federal scientists.[148] These references to peer review by two senior officials in a White House press briefing likely contributed to public perception of the Budget's findings as more exact and complete than the Budget, as an operational tool, was designed to be.

Quarters of the Oil Spilled in the Gulf is Gone, ST. PETERSBURG TIMES (Aug. 16, 2010); AFP *75 Percent Oil From Gulf of Mexico Spill is Gone: Official*.

[145] Email from Jane Lubchenco to Sean Smith, et al. (Aug. 4, 2010). The U.S. Geological Survey, which had also been involved in developing the Oil Budget tool and editing the report, expressed similar misgivings about the portrayal of the report. At 11:00 a.m., U.S. Geological Survey scientist Mark Sogge told a colleague, "We need to keep in mind, and make it clear to others, that this is NOT a [U.S. Geological Survey] product." Email from Mark Sogge to Stephen Hammond (Aug. 4, 2010).

[146] Email from Margaret Spring to Heather Zichal, et al. (July 30, 2010).

[147] White House Press Briefing, Robert Gibbs, Admiral Thad Allen, Carol Browner, and NOAA Administrator Jane Lubchenco, Washington, D.C. (Aug. 4, 2010), http://www.whitehouse.gov/the-press-office/press-briefing-press-secretary-robert-gibbs-admiral-thad-allen-carol-browner-and-dr. To reach the 50% figure, Administrator Lubchenco would have had to include as "gone" not only the 25% of the oil that was recovered at the wellhead, skimmed, or burned, but also the 25% that had evaporated or dissolved. Yet she also noted at the briefing that dissolved oil "in microscopic droplets that is still there may be toxic"; that "diluted and out of sight doesn't necessarily mean benign"; and that dissolved and dispersed oil are "pretty comparable." *Id.*; *see also infra* notes 149-50.

[148] White House Press Briefing (Aug. 4, 2010) (Lubchenco: "The report was produced by scientific experts from a number of different agencies, federal agencies, with peer review of the calculations that went into this by both other federal and non-federal scientists."; Browner: "This has all been—as Dr. Lubchenco said—been subjected to a scientific protocol, which means you peer review, peer review and peer review.").

B. The Oil Budget's Shortcomings

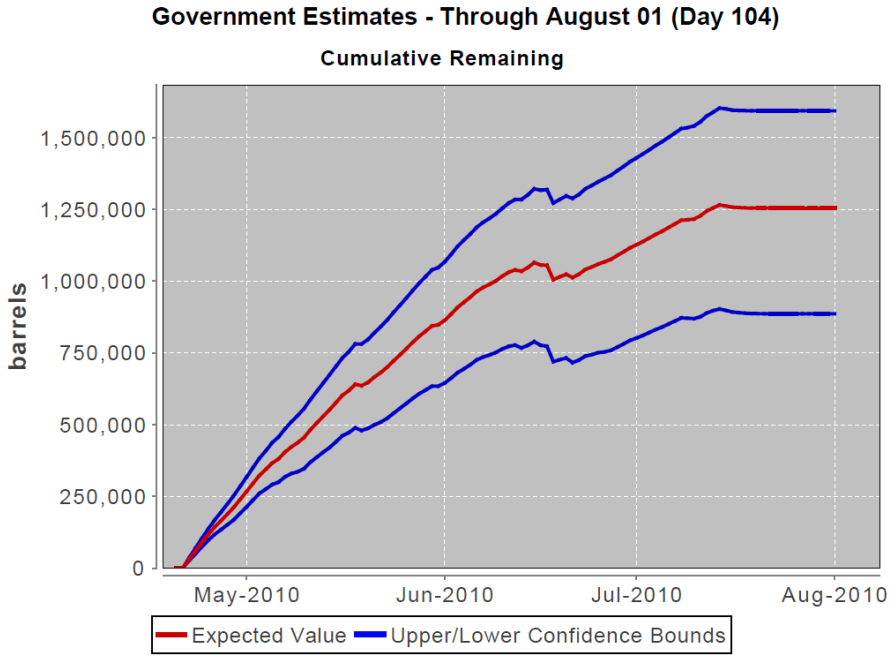
The Oil Budget was never meant to be a precise tool, and its rollout as a scientific report obscured some important shortcomings.

First, perhaps because the August 4 Oil Budget was originally intended for responders rather than for public evaluation, it did not disclose the formulas and assumptions upon which its estimates were based. Of the seven categories in which it provided estimates, "direct recovery" was the only one based on direct measurements. The Oil Budget Team built its assessment of the fate of the other 83% of the oil—roughly 4.1 million barrels—on formulas that it did not release at that time. It also presented estimates for those categories as fixed numbers or percentages, without attendant confidence intervals.

Second, and more important, the Oil Budget was simply not designed to explain, or capable of explaining, the "fate of the oil." Its purpose was to tell responders how much oil was present for clean-up operations, not to tell the public how much oil was "gone" from Gulf waters. Thus, it did not attempt to quantify biodegradation, or the exact amounts of remaining, dissolved, and dispersed oil, which were not the targets of response actions.

One of the *Gulf Incident Oil Budget*'s graphs (*see* Figure 2 below) illustrates that biodegradation was not a component of the budget. The amount of oil is depicted as constant following the July 15 well capping:

Figure 2



The Oil Budget's failure to account for biodegradation could result in over- or under-estimation of the amount of oil remaining in Gulf waters. On the one hand, oil that the Budget classified as "dispersed," "dissolved," or "evaporated" is not necessarily gone. Dispersed or dissolved oil may still be present in the water, and even evaporated oil remains in the atmosphere for a short time. As Administrator Lubchenco has stated, "dispersed or diluted doesn't necessarily mean benign."[149] On the other hand, oil that the Budget classified as "remaining" is not necessarily still present, as some portion may have already biodegraded. That category might have been better described as "other"—oil not included in any of the other categories. The *What Happened to the Oil* document did discuss the biodegradation issue, noting that "[o]il in the residual and dispersed categories is in the process of being degraded," and referencing early indications that the oil is "biodegrading quickly."[150] But because the August 4 Oil Budget did not provide sources or data to support this claim,[151] or define "quickly," this note seemed to increase, rather than address, public confusion about whether and how the budget demonstrated that most of the oil was "gone."

C. Early Reactions to the Oil Budget

The Oil Budget received immediate criticism. Critics focused on Ms. Browner's and Administrator Lubchenco's statements that the report had been peer-reviewed; on the decision to present the findings as fixed numbers rather than ranges, without disclosure of the underlying formulas;[152] and on the claim that the oil was "biodegrading quickly."[153] Scientists argued that the report painted a misleadingly optimistic picture of the situation in the Gulf, presenting uncertain information as fact.[154]

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[149] Renee Schoof, *NOAA Head: Scientists' Work on Gulf Spill Far From Done*, MCCLATCHY NEWSPAPERS (Sept. 15, 2010), http://www.mcclatchydc.com/2010/09/15/100645/noaa-head-scientists-work-on-gulf.html?storylink=MI_emailed. Similarly, when testifying before the Commission on August 25, Administrator Lubchenco noted that "even though [subsea oil] is dilute it is not necessarily benign. Dilute is not benign." She said that she "continue[d] to have grave concerns about the impact that that oil had when it was first released as well as continuing to have until it is completely biodegraded." Testimony of Administrator Lubchenco Before the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (Aug. 25, 2010), http://www.oilspillcommission.gov/meeting-2/video-2.

[150] WHAT HAPPENED TO THE OIL?; *see also* White House Press Briefing (Aug. 4, 2010) (Administrator Lubchenco, stating that most of the 50% of the remaining oil "is degrading rapidly or is being removed from the beaches").

[151] Commission staff have learned that, prior to the Oil Budget's release on August 4, authors of the report had been given access to a pre-publication draft of Dr. Terry Hazen's paper on the biodegradation rate of hydrocarbons released during the Deepwater Horizon spill (discussed in greater detail below). Email from Mark Miller to Stephen Hammond (July 31, 2010).

[152] For example, Representative Edward Markey (D-Massachusetts) asserted that the formulas and assumptions underlying the Oil Budget should have been made public at the same time as the findings, to permit independent verification. Katie Howell, *White House, Critics Reach Stalemate in Dispute Over Oil Budget in Gulf*, N.Y. TIMES (Aug. 23, 2010).

[153] David A. Fahrenthold, *Scientists Question Government Team's Report of Shrinking Gulf Oil Spill*, WASH. POST (Aug. 5, 2010); *see also* Howell, *White House, Critics Reach Stalemate in Dispute Over Oil Budget in Gulf*.

[154] *See, e.g.*, Fahrenthold, *Scientists Question Government Team's Report of Shrinking Gulf Oil Spill* (Quoting Dr. Ian MacDonald who stated that "[The *Oil Budget*] seems very reassuring, but the data aren't there to actually bear out the assurances that were made.").

The criticism that the August 4 Oil Budget was not a peer-reviewed scientific report was accurate. Even the independent scientists that were described as peer reviewers were critical of the report and the way it was presented. According to the *What Happened to the Oil* document, these scientists "consulted on the oil budget calculations, contributed field data, suggested formulas, analysis methods, or reviewed the algorithms used in the calculator."[155] When interviewed, many of these scientists described their contributions in similar terms, but they emphasized the large degree of uncertainty in their work and their impression that they were assisting in the development of an operational tool rather than a public government report.[156] Indeed, it is unclear whether any of the independent scientists actually reviewed the final report prior to its release.[157] In the words of consulting expert Ed Overton, "[t]o a scientist, peer review means something . . . . Clearly it wasn't a peer review from a scientific perspective."[158]

Administrator Lubchenco has since acknowledged that she was "in error" when claiming that the Oil Budget had been peer-reviewed.[159] NOAA has emphasized that the report's "purpose was to describe the short-term fate of the oil and to guide immediate efforts to respond to the emergency" rather than to "provide information about the impact of the oil" or "indicate where the oil is now."[160]

NOAA supplied these explanations on November 23, when it released a new version of the Oil Budget: *Oil Budget Technical Documentation*, a peer-reviewed report of over 200 pages that gave the formulas used and updated the percentages in the original Budget.[161] The new version's biggest change was its estimate of the amount of oil chemically dispersed, which doubled from 8% to 16%. Of this additional 8%, 3% came from the "naturally dispersed" category, 2% from the "evaporated or dissolved" category, and 3% from the "residual" category. (These changes brought the total amount of "residual" oil down from 26% to 23%.)[162]

As a tool for responders, the updated, peer-reviewed Oil Budget indicated that response and containment operations collected, eliminated, or dispersed about 41% of the oil, with containment ("direct recovery from wellhead") the most effective method, and chemical dispersants breaking down a substantial fraction. Response technology (skimming or burning) removed—as opposed to dispersed—only 8% of the oil.[163] Dispersion of the oil before it reached the surface limited the amount that responders could skim, burn, or disperse at the

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[155] WHAT HAPPENED TO THE OIL?
[156] Dan Froomkin, *NOAA Claims Scientists Reviewed Controversial Report; The Scientists Say Otherwise*, THE HUFFINGTON POST (Aug. 20, 2010), http://www.huffingtonpost.com/2010/08/20/noaa-claims-scientists-re_n_689428.html; Kate Sheppard, *NOAA's Supposed Peer Reviewers: We Never Reviewed the Report*, MOTHER JONES (Aug. 20, 2010), http://motherjones.com/blue-marble/2010/08/was-noaa-report-independently-evaluated.
[157] *Id*.
[158] Sheppard, *NOAA's Supposed Peer Reviewers: We Never Reviewed the Report*.
[159] Press Conference, *Jane Lubchenco Discusses Federal Peer-Reviewed "Oil Budget" Technical Documentation* (Nov. 23, 2010).
[160] Press Release, *NOAA, Federal Interagency Group Issues Peer-Reviewed 'Oil Budget' Technical Documentation* (Nov. 23, 2010).
[161] Oil Budget Team, OIL BUDGET CALCULATOR TECHNICAL DOCUMENTATION (Nov. 23, 2010).
[162] *Id*. at 40.
[163] *Id*.

surface. Nevertheless, responders considered burning an important success: it had never before been attempted on this scale, and burning techniques advanced during the spill.[164] Skimming was less of a success: despite the participation of hundreds of ships and thousands of people, it collected only 3% of the oil.[165]

D. Subsequent Scientific Research

Scientific reports on the fate of the oil from the Macondo well have been emerging since August. Some research has been peer-reviewed and published; other research is more preliminary. The peer-reviewed studies generally focus on the location of dispersed oil and other hydrocarbons and the rate at which they are biodegrading.[166] Although different research teams appear to be providing pieces missing from the Oil Budget and the larger puzzle regarding the fate of the oil, their findings suggest that understanding where the oil went will be an incremental process.

1. An Underwater Plume

The first important peer-reviewed scientific paper—by Camilli, et al., released on August 19—focused on the discovery of an underwater plume of hydrocarbons.[167] While conducting research in the Gulf of Mexico between June 19 and 28 Camilli's Woods Hole team found a continuous plume of highly diffuse hydrocarbons 35 kilometers long, 200 meters high, and 2 kilometers wide, at a depth of approximately 1,100 meters.[168] After determining that the Macondo spill was the source of the plume, the group estimated that the plume likely extended beyond the 35-kilometer boundary of the study. The Woods Hole researchers also examined the biodegradation rate by analyzing oxygen drawdown within the plume. The team was unable to find evidence of "systematic oxygen drawdown," which suggested that rapid biodegradation might not be occurring.[169]

The release of this study attracted considerable media attention, with many outlets focusing on whether it supported the conclusions of the Oil Budget.[170] The authors of the study tried to curtail this line of inquiry, describing the August 4 Oil Budget as a "first pass[]" that is part of a "foundation from which to work, road maps to use in assigning future research assets in

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[164] Interview with government official.
[165] Oil Budget Team, OIL BUDGET CALCULATOR TECHNICAL DOCUMENTATION, at 40 (Nov. 23, 2010).
[166] Oil was not the only hydrocarbon released from the Macondo well. Natural gas represented a significant percentage of the total discharge. Telephone Interview with Dr. Camilli (Sept. 10, 2010).
[167] Richard Camilli, et al., *Tracking Hydrocarbon Plume Transport and Biodegradation at* Deepwater Horizon, SCIENCE EXPRESS, at 1 (Aug. 19, 2010).
[168] *Id.* at 2.
[169] *Id.* at 3.
[170] Justin Gillis and John Collins Rudolf, *Oil Plume is Not Breaking Down Fast, Study Says*, N.Y. TIMES (Aug. 19 2010); Christopher Reddy, Op-Ed., *How Reporters Mangle Science on Gulf Oil*, CNN (Aug. 25, 2010), http://edition.cnn.com/2010/OPINION/08/25/reddy.science.media/index.html.

examining the transport and fate of oil in the Gulf of Mexico."[171] The Woods Hole study itself considered only one factor giving an indication of the biodegradation rate.

2. Further Work on Biodegradation

The next peer-reviewed paper to emerge, published on August 24, 2010, by Hazen, et al. and titled *Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria*, primarily focused on biodegradation of deep-sea plumes of hydrocarbons.[172] The Hazen team, researchers from Lawrence Berkeley National Laboratory, conducted their fieldwork between May 25 and June 2. Like the Woods Hole team, the Hazen team detected a subsea plume of hydrocarbons at a depth of 1,100-1,200 meters. Unlike Woods Hole, however, the team did find slight oxygen drawdown within the plume. The Hazen team also noted the type and density of the microbes in the plume and did laboratory tests to determine the biodegradation rate in terms of hydrocarbon half-life (1.2-6.1 days). Based on their findings, the researchers concluded that microbes were rapidly adapting in response to the presence of the subsea plume, and that the biodegradation rates for hydrocarbons were "faster than expected."[173] While the Hazen team's research suggests more rapid biodegradation, both Hazen and Camilli have described their studies as complementary rather than conflicting.[174] Both found deep sea plumes of hydrocarbons, with Hazen using different, more varied methods to estimate biodegradation.[175]

A third study related to biodegradation was produced by the National Incident Command's Joint Analysis Group on August 16, and found depressed, but not hypoxic, oxygen levels at the site of the Macondo well.[176] The group's study, conducted between May 8 and August 9, noted reduced oxygen levels at depths of 1,000 to 1,400 meters, which they interpreted as consistent with the presence of hydrocarbons from the Macondo well.[177] They did not find that oxygen drawdown was increasing over time. Their report concluded that oxygen levels were not decreasing because the oxygen depleted by biodegradation (as found by Hazen, et al.) was being replenished through the mixing of plume water with surrounding waters.[178]

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[171] Reddy, Op-Ed., *How Reporters Mangle Science on Gulf Oil*.
[172] Terry C. Hazen, et al., *Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria*, SCIENCE EXPRESS (Aug. 24, 2010).
[173] *Id*.
[174] Deborah Zabarenko, *Microbes Ate BP Oil Deep-Water Plume: Study*, REUTERS (Aug. 24, 2010), http://www.reuters.com/article/idUSTRE67N5CC20100824.
[175] *Id.*
[176] JOINT ANALYSIS GROUP, REVIEW OF PRELIMINARY DATA TO EXAMINE OXYGEN LEVELS IN THE VICINITY OF MC252#1 (Aug. 16, 2010), *available at* http://ecowatch.ncddc.noaa.gov/JAG/files/JAG_Oxygen_Report%20FINAL%20090410.pdf. Hypoxic oxygen levels lead to insufficient oxygenation of surrounding organisms' blood.
[177] *Id.* at 7.
[178] *Id.* at 8.

3. The Fate of All Hydrocarbons

Another peer-reviewed paper on the subject, *Propane Respiration Jump-Starts Microbial Response to a Deep Oil Spill*, was published on September 16 by Valentine, et al. and focused on the fate of all hydrocarbons rather than just oil.[179] Conducted from June 11-21, the study found subsea plumes in the vicinity of the Macondo well that included high concentrations of natural gas. To analyze biodegradation rates, the team looked at oxygen drawdown, as well as several other factors to determine which forms of hydrocarbons were being degraded.[180] They concluded that most of the initial biodegradation in the plumes involved gaseous hydrocarbons (propane and ethane), rather than oil. But they suggested that this initial degradation of gas could prime bacteria to degrade other hydrocarbons in the aging plumes.[181]

A more recent study also addressed biodegradation of the natural gas released during the spill. On January 6, 2011, Kessler, et al. published a peer-reviewed report titled: *A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico*.[182] Using samples taken between mid-August and early October, the researchers studied the fate of methane gas, the most abundant hydrocarbon released from the Macondo well.[183] In June, Valentine, et al. had detected elevated levels of methane in the vicinity of the wellhead. But, by mid-August, Kessler, et al. found that the methane had been consumed, though high levels of methane-consuming bacteria remained.[184] Based on these findings, the study concluded that "bacteria consumed all [methane gas] from the Deepwater Horizon event by the 18 August – 2 September survey."[185] These two studies together suggest that the gaseous hydrocarbons released during the spill have biodegraded rapidly.

4. Subsurface Oil Monitoring

On August 13, Admiral Allen issued a directive calling for an extensive study, conducted by independent and government scientists, to better understand how much oil remains in the Gulf and its impacts on the marine ecosystem.[186] To implement the directive, Admiral Paul Zukunft, then the Federal On-Scene Coordinator, issued an August 18 strategy document identifying three

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[179] David L. Valentine, et al., *Propane Respiration Jump-Starts Microbial Response to a Deep Oil Spill*, SCIENCE EXPRESS (Sept. 16, 2010).
[180] *Id*.
[181] *Id*. Other researchers, however, have made the converse suggestion to Commission staff: i.e., that the presence and biodegradation of gaseous hydrocarbons could slow the degradation of heavier liquid oil compounds. Telephone Interview with Dr. Camilli (Sept. 10, 2010).
[182] Kessler, et al., *A Persistent Oxygen Anomaly Reveals the Fate of Spilled Methane in the Deep Gulf of Mexico*, SCIENCE EXPRESS (Jan. 6, 2011).
[183] *Id*. at 1.
[184] *Id*. at 2-3.
[185] *Id*. at 2.
[186] Press Briefing, Admiral Thad Allen (Aug. 13, 2010), http://www.restorethegulf.gov/release/2010/08/13/transcript-press-briefing-national-incident-commander-admiral-thad-allen; Laura Parker, *NOAA Launches Mission to Solve BP Oil Mystery*, AOL NEWS (Sept. 24, 2010), http://www.aolnews.com/gulf-oil-spill/article/noaa-launches-mission-to-solve-bp-oil-mystery/19648228; Editorial, *Science and the Gulf*, N.Y. TIMES (Sept. 13, 2010).

goals: (1) "Monitor and assess the distribution, concentration, and degradation of the remaining portion of the oil that remains in the water column and/or bottom sediments"; (2) "Evaluate the distribution of indicators of dispersant or break-down products of dispersants used in oil spill response activities"; and (3) "Identify any additional response requirements that may be necessary to address remaining sub-surface oil."[187] He appointed NOAA the operational lead agency for the study.[188]

On September 15, Administrator Lubchenco acknowledged that oil was being found on the seafloor and promised that the government would "continue to monitor, sample and study the oil and [dispersants] from the near shore to the open ocean, from the surface to the seafloor . . . mindful of the need to understand how much oil remains, where it is and in what concentrations and how rapidly it's being naturally degraded."[189]

The government issued its *Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring* on December 17.[190] The report draws upon sampling conducted from early May until October 23 in three locations: "nearshore" (within three nautical miles of the shoreline); "offshore" (beyond three nautical miles and in less than 200 meters of water); and in "deep-water" (beyond three nautical miles and in more than 200 meters of water).[191] The report's results compare observed hydrocarbon levels to benchmark levels developed by the Environmental Protection Agency (EPA), which "identify conditions that may pose an immediate threat" to both human health and aquatic life.[192]

The study only considered human health benchmarks in the nearshore environment, and it concluded that the amount of hydrocarbons did not exceed those benchmarks. The study also concluded that, after August 3, the amount of hydrocarbons from the Macondo well (as opposed to other sources, like natural seeps) never exceeded the benchmarks for aquatic life in any of the three environments.[193] Finally, the study concluded that levels of chemical compounds found in dispersants did not exceed EPA benchmarks in either the nearshore or offshore environments (it did not analyze dispersant compounds in deepwater).[194]

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[187] Admiral Paul Zukunft, Memorandum to Admiral Thad Allen: *Sub-Sea and Sub-Surface Oil and Dispersant Detection, Sampling, and Monitoring Strategy* (Aug. 18, 2010).
[188] *Id*.
[189] Press Briefing and Teleconference, Admiral Thad Allen and NOAA Administrator Dr. Jane Lubchenco (Sept. 15, 2010), http://www.restorethegulf.gov/release/2010/09/15/transcript-press-briefing-and-teleconference-national-incident-commander-admiral-.
[190] Operational Science Advisory Team, Unified Area Command, SUMMARY REPORT FOR SUB-SEA AND SUB-SURFACE OIL AND DISPERSANT DETECTION: SAMPLING AND MONITORING (Dec. 17, 2010), http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf.
[191] *Id*. at 9.
[192] *Id*. (EPA's benchmarks were "designed to assess impacts on public health and aquatic life in the immediate context of removal action. The benchmarks utilized [were] intended to identify conditions that may pose an immediate threat to the environment; adverse effects (sub-lethal and long-term) could also occur at concentrations lower than the[] benchmarks.").
[193] *Id*. at 48.
[194] *Id*.

The study did find two areas of concern related to ocean sediments: (1) the amount of hydrocarbons in deepwater sediments within 3 kilometers of the wellhead exceeded the benchmark for aquatic life; and (2) "tar mats"—essentially oil mixed with sediment—were found in nearshore "shallow sub-tidal areas[.]"[195] Based on the report, Admiral Zukunft "determined that there is no actionable oil in the water or sediments of the deep water or offshore zones. Ongoing removal operations will continue where oil remains in nearshore sediments and shorelines."[196] While the report also evaluated peer-reviewed studies on biodegradation (including those discussed above), it concluded that "[t]he degradation rates for the complete mixture of compounds that characterize [Macondo] oil have not yet been determined."[197]

Ongoing field studies have identified similar areas of concern, detecting oil in ocean sediment. In early August, a team from the University of South Florida found oil droplets in marine sediment in the DeSoto Canyon, an underwater fissure that runs from the Macondo site towards the coast of Florida.[198] Recently, the researchers compared these droplets to Macondo oil by measuring their relative concentrations of carbon atoms. The two were "a perfect match."[199]

In September, Dr. Samantha Joye, a professor of Marine Sciences at the University of Georgia,[200] took sediment samples in the Gulf of Mexico and found a layer of oily substance covering the ocean floor in the region of the Macondo well.[201] These samples contained significantly less than 1% oil, but Dr. Joye maintains that this fraction is still "1,000 times more oil than you'd usually find in gulf mud."[202] More recently, in November, Dr. Joye led an

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[195] *Id*.
[196] Admiral Paul Zukunft, letter to Admiral Robert C. Parker, 3 (Dec. 17, 2010).
[197] Operational Science Advisory Team, Unified Area Command, SUMMARY REPORT FOR SUB-SEA AND SUB-SURFACE OIL AND DISPERSANT DETECTION: SAMPLING AND MONITORING, at 47.
[198] Vickie Chachere, *USF Scientists Detect Oil on Seafloor*, UNIVERSITY OF SOUTH FLORIDA NEWS (Aug. 17, 2010), http://usfweb3.usf.edu/absoluteNM/templates/?a=2604&z=120.
[199] Barry Yeoman, *"Slime Snot" on Gulf Seafloor More Closely Linked to Missing BP Oil*, ONE EARTH BLOG (Dec. 10, 2010), http://www.onearth.org/blog/slime-snot-on-gulf-seafloor-more-closely-linked-to-missing-bp-oil; Jeffrey Ball, *Strong Evidence Emerges of BP Oil on Seafloor*, WALL ST. J. (Dec, 9, 2010).
[200] Dr. Joye is also part of the Georgia Sea Grant, an "ad hoc group of university-based oceanographic experts" that released a report criticizing the Oil Budget on August 17. Georgia Sea Grant, *Outcome/Guidance from Georgia Sea Grant Program: Current Status of BP Oil Spill* (Aug. 17, 2010), http://uga.edu/aboutUGA/joye_pkit/GeorgiaSeaGrant_OilSpillReport8-16.pdf. Based largely on the figures in the Oil Budget, but using different methodologies and assumptions, the report estimated that a full 70-79% of the 4.1 million barrels of oil released into Gulf waters was still remaining at the time of publication. The report attempted to account for biodegradation, using an estimate of 5%-10% based on data from earlier spills. The Georgia Sea Grant report has been criticized as based upon insufficient data and for underestimating the rate of biodegradation. *See, e.g.*, John Collins Rudolph, *Scientists Tussle Over Gulf Oil Tally*, N.Y. TIMES (Aug. 17, 2010), http://green.blogs.nytimes.com/2010/08/17/tussle-over-gulf-oil-tally-drags-on/.
[201] Cain Burdeau and Seth Bornstein, *Where's the Oil? On the Gulf Floor, Scientists Say*, ST. PETERSBURG TIMES (Sept. 13, 2010); Richard Harris, *Scientists Find Thick Layer of Oil on Seafloor*, NATIONAL PUBLIC RADIO (Sept. 10, 2010), http://www.npr.org/templates/story/story.php?storyId=129782098; Samantha Joye, *Focusing in on Oil*, GULF OIL BLOG (Sept. 5, 2010), http://gulfblog.uga.edu/2010/09/focusing-in-on-oil/.
[202] Richard Harris, *Seafloor Samples Show Troubling Effects Of Oil Spill*, NATIONAL PUBLIC RADIO (Dec. 9, 2010), http://www.npr.org/2010/12/09/131932746/seafloor-samples-show-devastating-effect-of-oil-spill?ps=cprs.

expedition that discovered a "brown haze covering the sea floor" alongside dead coral about 10 miles from the Macondo well.[203] These findings are supported by other reports of dead or dying deepwater corals on rock outcrops within seven miles of the Macondo well.[204] To date, the research conducted by the University of South Florida team and Dr. Joye has not been published in a peer-reviewed study.

Suggestions for the Commission's Consideration:

- Certain statements by administration officials to the effect that the Oil Budget was a "peer-review[ed]" scientific report, and that it concluded 75% of the oil was "gone," were inaccurate and led to news reports that were misleading. In fact, the Oil Budget was a rough operational tool, and its findings were neither as clear nor as reassuring as the initial rollout suggested.

- The Commission may wish to consider recommending that government scientific study groups disclose more of their underlying methodologies, assumptions, and data contemporaneously, allowing for greater review and input from the rest of the scientific community.

- The fate and impacts of oil released from the Macondo well are unlikely to be resolved in the short term.[205]

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[203] *Id*.
[204] Mark Schrope, *Oil spill cruise finds field of dead coral: Scientific Expedition Assesses Deep-Sea Damage in the Gulf of Mexico*, NATURE NEWS (Nov. 5, 2010), http://www.nature.com/news/2010/101105/full/news.2010.589.html.
[205] This finding is supported by a recent Congressional Research Service report, which concluded that "[a] complete and definitive answer to the question of the *remaining* oil is unknown at this juncture. . . . It is debatable whether the fate of the remaining oil will ever be established conclusively. . . . Regardless, the question of oil fate will likely be addressed through an incremental process." Congressional Research Service, DEEPWATER HORIZON OIL SPILL: THE FATE OF THE OIL 17 (Dec. 16, 2010).