

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

## THE AMOUNT AND FATE OF THE OIL

---Draft---

### Staff Working Paper No. 3

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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 flow 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.

Federal government responders may be correct in stating that low flow-rate estimates did not negatively affect their operations.<sup>1</sup> Even if responders are correct, however, 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.<sup>2</sup> More extensive, peer-reviewed government reports, which will allow for greater substantive evaluation of government estimates related to flow rate and fate, are forthcoming. In the meantime, this paper discusses some of the key government estimates with a view towards eventual Commission findings regarding whether flow-rate estimates should have been more accurate from the outset, and whether the government

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<sup>1</sup> As explained further in Part I.B below, Commission staff is still gathering information with which to evaluate responders' assertions.

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

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.

## **I. FLOW RATE: THE AMOUNT OF OIL RELEASED**

This Part of the paper describes governmental and non-governmental 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-governmental 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, 2010, 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.<sup>3</sup> On the morning of April 22, 2010, 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).<sup>4</sup> Later that morning, Deepwater Horizon sank, leaving a one mile by five mile sheen on the ocean's surface.<sup>5</sup>

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. Non-governmental 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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<sup>3</sup> 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>.

<sup>4</sup> 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/>.

<sup>5</sup> 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.<sup>6</sup> 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, 2010, 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.”<sup>7</sup>

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.<sup>8</sup>

After the discovery of these leaks on April 24, 2010, Coast Guard and BP officials put out an estimate: Up to 1,000 bbls/day were flowing from the two leaks in the riser.<sup>9</sup> Neither the Coast Guard nor BP divulged the data or methodology behind this estimate. Based on the information we have to date, it appears the figure came from BP without supporting documentation.<sup>10</sup>

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, 2010, Admiral Landry stated that “NOAA experts believe the output could be as much as 5,000 barrels.”<sup>11</sup> Although Admiral Landry did not provide further explanation, the media speculated that this latest estimate was derived through a method known as the “Bonn Convention.”<sup>12</sup> 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.<sup>13</sup>

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<sup>6</sup> Press Conference, Admiral Mary Landry and Doug Suttles, New Orleans, LA (Apr. 28, 2010), [http://cgvi.uscg.mil/media/main.php?g2\\_itemId=843309](http://cgvi.uscg.mil/media/main.php?g2_itemId=843309).

<sup>7</sup> 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>.

<sup>8</sup> 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).

<sup>9</sup> See, e.g., Press Release, Unified Command, Unified Command Continues to Respond to Deepwater Horizon (Apr. 25, 2010), <http://app.restorethegulf.gov/release/2010/04/25/update-7-unified-command-continues-respond-deepwater-horizon-0>; Robertson, *Oil Leaking Underwater From Well in Rig Blast*.

<sup>10</sup> Interviews with government officials.

<sup>11</sup> Press Conference, Admiral Mary Landry and Doug Suttles, New Orleans, LA (Apr. 28, 2010); Tim Dickinson, *The Spill, the Scandal, and the President*, ROLLING STONE (June 8, 2010).

<sup>12</sup> 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).

<sup>13</sup> 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](http://response.restoration.noaa.gov/book_shelf/1462_FINAL%20OWJA%202007.pdf).

Based on the information currently available to Commission staff, the source of the 5,000 bbls/day estimate appears to have been an unsolicited, one-page document emailed to Admiral Landry's Scientific Support Coordinator on April 26, 2010, by a NOAA scientist.<sup>14</sup> The scientist derived an "estimated present volume release rate" of roughly 5,000 bbls/day, based on visual observation of the speed at which oil was leaking from the end of the riser.<sup>15</sup> While 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, he did not base his flow-rate estimate on that surface volume estimate. (He noted, moreover, that estimating surface volume from the visual appearance of an oil slick was "a highly unreliable process.")<sup>16</sup>

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.<sup>17</sup> Further, there is no indication that the scientist had expertise in estimating deep-sea flow velocity from video data or that he 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[.]".<sup>18</sup> 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.<sup>19</sup>

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, 2010.<sup>20</sup>

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<sup>14</sup> NOAA Document. The scientist also verbally noted to the Scientific Support Coordinator that the flow rate might be upwards of 10,000 bbls/day. Internal NOAA e-mail.

<sup>15</sup> NOAA Document. 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).

<sup>16</sup> *Id.*; Interview with government official. The surface volume calculation was based on an American Society for Testing and Materials standard for determining surface oil thickness. The scientist also assumed that at least half of the oil released evaporated or dispersed in the water column before reaching the surface. Based on those assumptions, the surface volume estimate could have confirmed or yielded a flow-rate estimate of 5,000 bbls/day. E.g., if the oil first began leaking on April 22, 2010, 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. The one-page document, however, did not take these steps. Instead, it estimated the "present volume release rate" of 5,000 bbls/day based on visual observation of the velocity of the oil plume leaking from the riser.

<sup>17</sup> 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).

<sup>18</sup> Internal NOAA e-mail.

<sup>19</sup> Interview with government official. On the day following the release of the 5,000 bbls/day estimate, President Obama made his first public statement about the spill and Secretary of Homeland Security Janet Napolitano declared 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).

<sup>20</sup> 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>.

## 2. Non-governmental Estimates

From the outset, estimates from non-governmental 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 Satellite Imagery*

The first independent flow-rate estimate surfaced on April 27, 2010, at the time the official estimate was 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.<sup>21</sup> 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.<sup>22</sup> Within days, Amos's estimate appeared in the national press.<sup>23</sup>

On May 1, 2010, 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. Like Amos, he assumed that none of the oil had burned, evaporated, dispersed, been skimmed, or was then below the surface.<sup>24</sup>

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 thickness from aerial data.<sup>25</sup> 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

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<sup>21</sup> 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>.

<sup>22</sup> *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.

<sup>23</sup> 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>.

<sup>24</sup> 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>.

<sup>25</sup> Achenbach, *How big is Gulf Spill, Really?*; Gillis, *Size of Oil Spill Underestimated, Scientists Say*; NOAA Paper, *Visual Observations and the Bonn Agreement*.

surface volume estimate appears to have been based on an unexplained assumption that 99% of the spill was 0.1 microns thick, while the remainder was 100 microns thick.<sup>26</sup> Thus, while estimating volume from surface appearance may be inherently unreliable, the non-government scientists appeared to make greater efforts to be clear and rigorous in their methodologies, possibly leading their estimates to be closer to the actual flow rate (though still far off).

*b. Estimates Based on Video of the Flow*

On May 12, 2010, BP released a thirty-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.<sup>27</sup>

- **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.<sup>28</sup> 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.<sup>29</sup>
- **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.<sup>30</sup> Dr. Chang 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 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.<sup>31</sup>
- **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

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<sup>26</sup> NOAA Document.

<sup>27</sup> 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>.

<sup>28</sup> *Id.*; Raymond Gellner, *BP Oil Spill Rate in Gulf May Be 3 Million Gallons Per Day*, WORLD NEWS EXAMINER (May 14, 2010); Telephone Interview 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.

<sup>29</sup> 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).

<sup>30</sup> Harris, *Gulf Spill May Far Exceed Official Estimates*.

<sup>31</sup> *Id.*; Telephone Interview with Dr. Eugene Chiang, University of California at Berkeley (Aug. 13, 2010).

(±20%).<sup>32</sup> 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.<sup>33</sup> Dr. Wereley co-authored a 2007 book on this flow-rate estimation method.<sup>34</sup>

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.<sup>35</sup> 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.

BP attempted to dismiss the Crone, Chiang, and Wereley estimates. It told *National Public Radio* on May 13, 2010, that “there’s no way to estimate the flow coming out of the pipe accurately.”<sup>36</sup> 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 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.<sup>37</sup>

The Crone, Chiang, and Wereley estimates proved to be significantly more accurate than the 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 the early official flow estimates 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

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<sup>32</sup> 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).

<sup>33</sup> *Id.*

<sup>34</sup> RAFFEL, WILLERT, WERELEY, & KOMPENHANS, *PARTICLE IMAGE VELOCIMETRY: A PRACTICAL GUIDE* (2d ed. 2007).

<sup>35</sup> 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 and concluded that the flux was 43.7% oil.

<sup>36</sup> 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>; 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>.

<sup>37</sup> *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).

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 federal 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. Commission staff is still in the process of evaluating these assertions. Because the worst-case figures that emerged within days of the spill, although imprecise, ended up being roughly equivalent to the actual flow rate, we cannot at this point conclude that inaccurate official estimates adversely impacted the response and clean-up operations. It may, however, have been better practice for the government to disclose the estimates that drove the Unified Command operational plan—that is, the operational worst-case discharge figures. Moreover, it is possible that inaccurate flow-rate figures may have hindered the subsea efforts to stop and to contain the flow of oil at the wellhead. A later staff working paper will consider the impact, if any, of flow-rate estimates on well control and containment.

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).<sup>38</sup> A high-level official, however, told us that the Coast Guard did not believe the figure from the drilling plan was a credible worst-case estimate.<sup>39</sup> On April 23, 2010, the Coast Guard and NOAA received an updated estimate of 64,000-110,000 bbls/day, which appeared in both an

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<sup>38</sup> 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>.

<sup>39</sup> Interview with Coast Guard official.

internal Coast Guard Situation Report and on a dry-erase board in the NOAA Seattle war room.<sup>40</sup> By early May, BP had lowered its worst-case estimate to 60,000 bbls/day.<sup>41</sup> BP officials disclosed a similar estimate to Congress on May 4, 2010, 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 . . . .”<sup>42</sup>

Thus, although there is evidence to suggest that the worst-case discharge figures BP disclosed to the Unified Command and Congress did not conform to its internal worst-case estimates,<sup>43</sup> front-line responders may 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, 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, 2010, 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.”<sup>44</sup> Responders stuck to this blueprint, stating that, while 1,000 or 5,000 bbls/day were the official best flow-rate estimates, the government was scaling the response to an *unquantified* worst-case scenario.<sup>45</sup>

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<sup>40</sup> 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](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.

<sup>41</sup> Interviews with government officials.

<sup>42</sup> 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](http://markey.house.gov/index.php?option=com_content&task=view&id=4076&Itemid=141).

<sup>43</sup> In May 2010, BP turned over a document to congressional investigators that demonstrated that their in-house estimates were as follows: “[e]xpected range of possible flow rates is 5,000 to 40,000 BOPD,” the “[m]aximum theoretical flow rate is 60,000 BOPD,” and, if the BOP and wellhead are removed, “the rate could be as high as ~ 100,000 barrels per day . . . .”; BP WORST CASE SCENARIO DOCUMENT, *available at* <http://globalwarming.house.gov/files/WEB/flowrateBP.pdf>; Ernest Scheyder, *BP Estimates Oil Spill Up to 100,000 Barrels Per Day in Document*, REUTERS (June 20, 2010), <http://www.reuters.com/article/idUSN1416392020100620>; 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/>.

<sup>44</sup> 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](http://blog.al.com/live/2010/04/deepwater_horizon_secret_memo.html).

<sup>45</sup> *See, e.g.*, Press Briefing, Admiral Thad Allen (May 1, 2010), <http://www.marinelog.com/DOCS/NEWSMIX/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

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 the Unified Command level.<sup>46</sup> The Commission staff has also been advised that, in late April or early May 2010, NOAA wanted to make public some of its long-term, worst-case discharge models for the Deepwater Horizon spill, and requested approval to do so from the White House's Office of Management and Budget.<sup>47</sup> Staff was told that the Office of Management and Budget denied NOAA's request.<sup>48</sup>

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.<sup>49</sup>

#### **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, as it appears they did here, 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.”<sup>50</sup>

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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.”)

<sup>46</sup> Interviews with government officials.

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

<sup>49</sup> See Draft Staff Working Paper: *Decision-Making Within the Unified Command*, National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, at § II(B).

<sup>50</sup> 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>.

### C. The Flow Rate Technical Group

Although responders stated that accurate flow-rate estimates were not important to their operations, the Unified Command eventually felt a need to assert leadership on the issue, possibly as a result of media attention and public criticism of the low early numbers.<sup>51</sup> On May 19, 2010, the National Incident Command spearheaded the creation of an inter-agency 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.<sup>52</sup> On May 23, 2010, 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.<sup>53</sup>

The Flow Rate Group was originally comprised of three sub-groups, made up of both governmental and non-governmental 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-governmental scientists with applicable expertise and experience, including Dr. Wereley, a critic of the low early estimates. The Group's initial estimates, however, proved chronically low, too. Moreover, the Group's later, more accurate estimates relied primarily upon data collected by a team led by Secretary of Energy Dr. Steven Chu and a team from the Woods Hole Oceanographic Institution, though the Group did play a significant role in analyzing and interpreting this data.

The initial success of the Flow Rate Group is questionable given that it did not release an arguably accurate flow-rate estimate until mid-June, when Secretary Chu's team was able to provide the Group with data. The Group's estimates may also have suffered from a failure to disclose enough information to enable other experts to assess the group's methodologies and findings. If more of the Group's data had been made public, its estimates may have evolved more rapidly with input from the broader scientific community.<sup>54</sup>

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<sup>51</sup> Interview with government official.

<sup>52</sup> 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>.

<sup>53</sup> Coast Guard Document.

<sup>54</sup> On September 16, 2010, Public Employees for Environmental Responsibility (PEER), an environmental whistleblower group, filed a complaint in the U.S. District Court for the District of Columbia under the Freedom of Information Act seeking to compel the U.S. Geological Survey to produce documents related to the Flow Rate Group. PEER requested these records "in order to learn about how the [U.S. Geological Survey] and the [Flow Rate Group] developed a scientific estimate of the rate of oil leaking from the BP Deepwater Horizon blowout in the Gulf of Mexico." Complaint at 2, *Pub. Emp. for Envtl. Responsibility v. Dep't of Interior* (D.D.C. filed Sept. 16, 2010).

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

The Flow Rate Group published its first estimate on May 27, 2010, 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].”<sup>55</sup> 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.”<sup>56</sup>

On June 2, 2010, the Flow Rate Group released a three page *Summary Preliminary Report* that explained the May 27, 2010 estimate in more detail.<sup>57</sup> That document noted that the Plume Team produced “a range of lower bounds” of 12,000 to 25,000 bbls/day ( $\pm 40\%$ ), but did not elaborate on the underlying data or calculations.<sup>58</sup> Moreover, the June 2, 2010 report did *not* include the upper ranges of the Plume Team’s estimates 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.”<sup>59</sup> 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.<sup>60</sup> Further, the Plume Team’s report originally contained appendices that revealed some divergence of opinion within the Team.<sup>61</sup> The appendices were not publicly released.

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

On June 10, 2010, 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.<sup>62</sup> 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

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<sup>55</sup> 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>.

<sup>56</sup> *Id.*

<sup>57</sup> 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>.

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> Interview with non-governmental source.

<sup>61</sup> E-mail from Steven Wereley to members of the Flow Rate Technical Group’s Plume Team (May 27, 2010), available at <http://www.usgs.gov/foia/budget/05-27-2010...experts%20statements%201.pdf>.

<sup>62</sup> 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->.

members of the Plume Team, but only after a “statistical procedure” was applied to “reconcile” the different members’ full ranges.<sup>63</sup>

The June 10, 2010 press release also noted an estimate by researchers with Woods Hole, 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, 2010, 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).<sup>64</sup> Along with the Flow Rate Group’s press release, the government released a brief one-page statement by the Woods Hole team explaining the methodology behind its estimate.<sup>65</sup> 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, 2010 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.<sup>66</sup> These two teams did not contribute to the June 10 or June 15 estimates. Their purpose was to arrive at a peer-reviewed, final estimate, while the Plume and Mass Balance Teams focused on generating preliminary estimates for public release and for use during the spill.<sup>67</sup>

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

On June 15, 2010, 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 of the Interior Ken Salazar.<sup>68</sup> According to the accompanying press release, the new estimate was

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<sup>63</sup> 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 noting: “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>.

<sup>64</sup> 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.

<sup>65</sup> 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>.

<sup>66</sup> 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).

<sup>67</sup> Interviews with government officials.

<sup>68</sup> 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>.

“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.”<sup>69</sup> No additional information on methodology was provided.

We now know that the high end of this estimate was accurate because of pressure readings from a sensor that Secretary Chu’s team had BP place in the Top Hat above the blowout preventer on June 13, 2010.<sup>70</sup> 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 estimate of approximately 60,000 bbls/day.<sup>71</sup>

On June 14, 2010, Secretary Chu and his team, Secretary Salazar, and members of the Flow Rate Group hosted a conference call.<sup>72</sup> On the call, the teams decided that they would jointly announce a flow-rate range of 35,000-60,000 bbls/day. The Chu team’s estimate accounted for the high end of the range, while the Flow Rate Group’s work provided the low end.<sup>73</sup>

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

The June 15, 2010 estimate was finally updated on August 2, 2010. A press release announced that, at the outset of the spill, the flow rate was 62,000 bbls/day ( $\pm 10\%$ ), but that it had declined to 53,000 bbls/day ( $\pm 10\%$ ) by the time the well had been capped on July 14, 2010.<sup>74</sup>

Another document released on August 4, 2010, the *Deepwater Horizon MC252 Gulf Incident Oil Budget*, provides some additional details, but none concerning the data upon which the June 15, 2010 estimate was based. It notes only 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.”<sup>75</sup>

We now understand that Secretary Chu’s team calculated the 52,700 bbls/day figure by taking pressure readings on July 14, 2010, 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 into the Gulf was an opening in the capping stack’s kill line. Pressure readings

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<sup>69</sup> *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.

<sup>70</sup> Interviews with government officials; *see also* Henry Fountain, *BP Provides Plan to Speed Up Siphoning*, N.Y. TIMES (June 14, 2010).

<sup>71</sup> Interviews with government officials.

<sup>72</sup> NOAA Document.

<sup>73</sup> Interviews with government officials.

<sup>74</sup> 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>.

<sup>75</sup> OIL BUDGET at 1.

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 ten percent.<sup>76</sup>

Once the capping stack was closed on July 15, 2010, the pressure from the reservoir was about 2,000 psi lower than anticipated, signaling that it had decreased by that amount during 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 spill, based on the Woods Hole finding that 43.7% of the total flux was oil.<sup>77</sup> Given the new figures, the *Deepwater Horizon MC252 Gulf Incident Oil Budget* concluded that the total amount of oil discharged during the spill was 4,928,100 barrels ( $\pm 10\%$ , 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.<sup>78</sup>

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 paper. Release of this paper will allow for a better assessment of the Group's work and value. It is worth noting now, however, that the Flow Rate Group did not succeed in releasing an accurate high-end estimate until mid-June and that Secretary Chu's team, rather than any of the Group's teams, appears to have been responsible for the accuracy of that June 15 estimate. Moreover, the best currently available data on flow rate were collected by Secretary Chu's team and the Woods Hole team, although the Flow Rate Group's Reservoir and Nodal Analysis Teams, established in June, played a significant role in interpreting and analyzing the data to arrive at the current government estimate.

#### **Suggestions for the Commission's Consideration:**

- The Flow Rate Group may be a valuable model for integration of outside scientific expertise, and the Commission may wish to recommend certain methodologies used by the Group as best practices. However, the Commission may also wish to recommend a review of why the Group's estimates were initially inaccurate. Finally, the Commission may want to consider whether scientific working groups such as the Flow Rate Group should disclose more of their underlying data and methodologies, allowing for greater input from the rest of the scientific community.

#### **D. Final Government Estimate Versus Estimates of Independent Scientists**

The flow-rate estimates of non-governmental 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

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<sup>76</sup> Interview with government official.

<sup>77</sup> Interviews with government officials.

<sup>78</sup> OIL BUDGET at 1.

referenced above, they conclude that, from April 22, 2010, until the riser was cut on June 3, 2010, the flow rate was 55,900 bbls/day ( $\pm 21\%$ ); and that between June 3 and July 15, 2010, when the well was capped, the flow was 67,500 bbls/day ( $\pm 19\%$ ).<sup>79</sup> Crone and Tolstoy estimate the total release to be 5,174,887 barrels ( $\pm 20\%$ ).<sup>80</sup> 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, 2010.<sup>81</sup> If the kink leak were taken into account, and the oil ratio was increased to the 43.7% figure generated by the Woods Hole team, this estimate would be on the high end of the government's current estimate for the total release.

The Woods Hole team also generated an estimate for the total flow from the well.<sup>82</sup> On May 31, 2010, with the aid of the Coast Guard, Woods Hole took readings from the end of the broken riser and kink leak. The measurements at each site were taken using an ROV-mounted acoustic Doppler current profiler to determine velocity, and imaging multi-beam sonar to determine flow volume.<sup>83</sup>

Following the Flow Rate Group's press release on June 10, 2010, the Woods Hole team refined its data and factored in the assumption that oil accounted for 43.7% of the total flux.<sup>84</sup> With this new assumption, the team concluded that, on May 31, 2010, 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.<sup>85</sup> Using that figure and the 53,000 bbls/day estimate for July 14, 2010 generated by Secretary Chu's team, the Woods Hole team calculated the declining flow rate over time, from April 22 to July 14, 2010. The team estimated a total release of approximately five million barrels during the course of the spill.<sup>86</sup>

The emerging consensus is that roughly five million barrels of oil were released by the Macondo well, with roughly 4.2 million barrels pouring into the waters of the Gulf of Mexico. Using different methods, the government teams and independent scientists arrived at the same approximate figure.

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<sup>79</sup> Timothy J. Crone, et al., *Magnitude of the 2010 Gulf of Mexico Oil Leak*, SCIENCE EXPRESS, at 1 (Sept. 23, 2010); Telephone Interview with Dr. Crone (Aug. 18, 2010 and Sept. 3, 2010).

<sup>80</sup> *Id.*

<sup>81</sup> *Id.*

<sup>82</sup> Woods Hole was originally contacted by BP on May 1, 2010 to undertake diagnostic work on the failed blowout preventer, which would include measuring the flow rate. BP, however, cancelled the project, citing a need to focus on the containment dome effort. *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).

<sup>83</sup> 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).

<sup>84</sup> *Id.* Scientists from Woods Hole took measurements at the source and concluded that 43.7% of the flux was oil.

<sup>85</sup> Telephone Interview with Dr. Camilli (Sept. 10, 2010).

<sup>86</sup> *Id.*

## **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 draft 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.”

Section A briefly describes the background to the 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 early reaction to the Oil Budget. 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.

### **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.<sup>87</sup> 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.<sup>88</sup> On June 11, 2010, 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.<sup>89</sup> Experts from NOAA, the National Institute of Standards and Technology, and the United States Geological Survey formed the Oil Budget Calculator Science and Engineering

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<sup>87</sup> 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.noaa.gov/stories2010/PDFs/OilBudget\\_description\\_%2083final.pdf](http://www.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf); U.S. Geological Survey Document.

<sup>88</sup> U.S. Geological Survey Document.

<sup>89</sup> Interview with government officials.

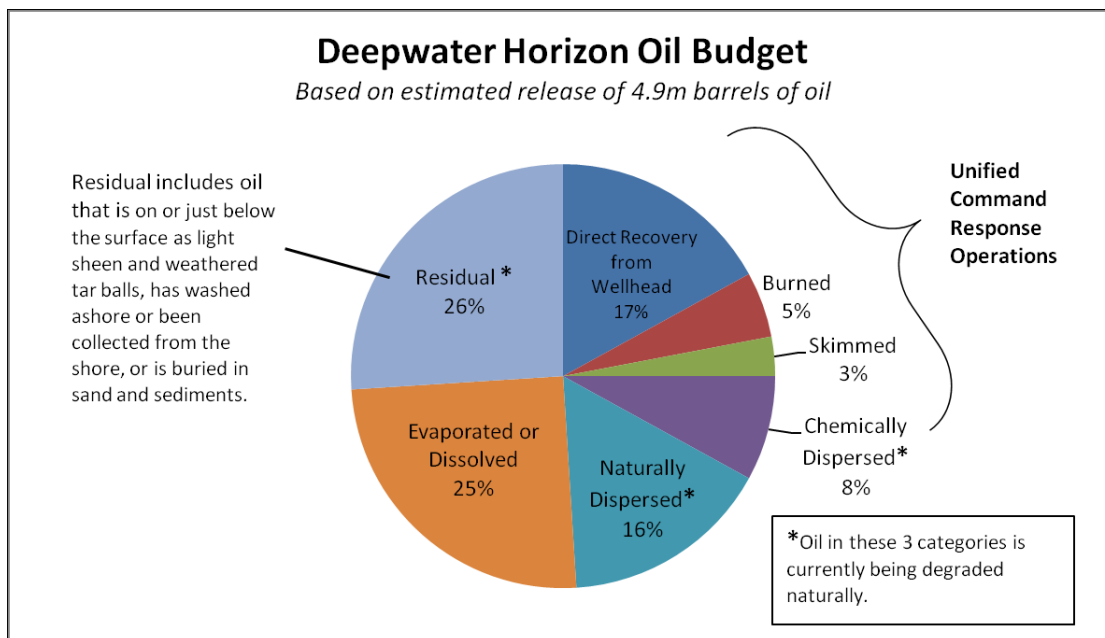
Team (Oil Budget Team) to develop the tool, which relied upon flow-rate data from the Flow Rate Group.<sup>90</sup>

The Oil Budget Team’s tool was ready for use by July 6, 2010.<sup>91</sup> 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.<sup>92</sup>

## 2. Fate of the Oil Estimates

On August 4, 2010, the Oil Budget Team released *Deepwater Horizon MC252 Gulf Incident Oil Budget (Gulf Incident Oil Budget)*<sup>93</sup> and a supporting document entitled *BP Deepwater Horizon Oil Budget: What Happened to the Oil (What Happened to the Oil)*<sup>94</sup> (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, 2010), a total of 4,928,100 barrels ( $\pm 10\%$ , which gives a range of 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**



<sup>90</sup> 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%20Oil%20Budget.pdf>.

<sup>91</sup> Interview with government official.

<sup>92</sup> U.S. Geological Survey Document.

<sup>93</sup> OIL BUDGET.

<sup>94</sup> WHAT HAPPENED TO THE OIL?

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.<sup>95</sup> If these higher subsea ratios are correct, more oil may have been chemically dispersed than is accounted for in the 8% figure.
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.<sup>96</sup>
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.”<sup>97</sup> The Oil Budget Team contemplated using the label “other” for this category, but decided against doing so.<sup>98</sup> *What Happened to the Oil* notes that the residual category “includes oil still on or just below the surface in the form

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<sup>95</sup> 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 <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>.

<sup>96</sup> 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).

<sup>97</sup> OIL BUDGET.

<sup>98</sup> Interview with government officials.

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.”<sup>99</sup>

### 3. The Rollout of the Budget

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, 2010, the Director of the White House Office of Energy and Climate Change Policy, Carol Browner, appeared on *ABC*, *CBS*, *NBC*, *MSNBC*, and *Fox News* morning shows to discuss the success of the static kill effort and the conclusions of the Oil Budget Team.<sup>100</sup>

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.”<sup>101</sup>
- “The scientists are telling us about 25 percent was not captured or evaporated or taken care of by mother nature.”<sup>102</sup>

Subsequent headlines on August 4, 2010 reflected these characterizations: “75 percent of spilled Gulf oil gone, White House says.”<sup>103</sup> The Oil Budget Team’s findings, however, did not

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<sup>99</sup> WHAT HAPPENED TO THE OIL? at 2.

<sup>100</sup> 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](http://www.huffingtonpost.com/2010/08/20/overly-rosy-report-on-oil_n_688142.html).

<sup>101</sup> 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/>; see also 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> (“Dispersants played a small role, they weren’t the only reason why almost 75% of the oil has been contained and is gone.”).

<sup>102</sup> 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/ALeqM5h1qkjFdSvSOH6qmoXacsi4EtmjQ>.

<sup>103</sup> 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](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.”

The Oil Budget rollout continued on the afternoon of August 4, 2010 with a White House press briefing attended by Ms. Browner, White House Press Secretary Robert Gibbs, Admiral Thad Allen, and NOAA Administrator Dr. Jane 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 percent—“of the oil that was released is now completely gone from the system.”<sup>104</sup>

In addition, Ms. Browner and Administrator Lubchenco emphasized that the report was “peer-review[ed]” by federal and non-federal scientists.<sup>105</sup> 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.

## **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 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 unreleased formulas. It also presented estimates for those categories as fixed numbers or percentages, without attendant confidence intervals.

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*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*.

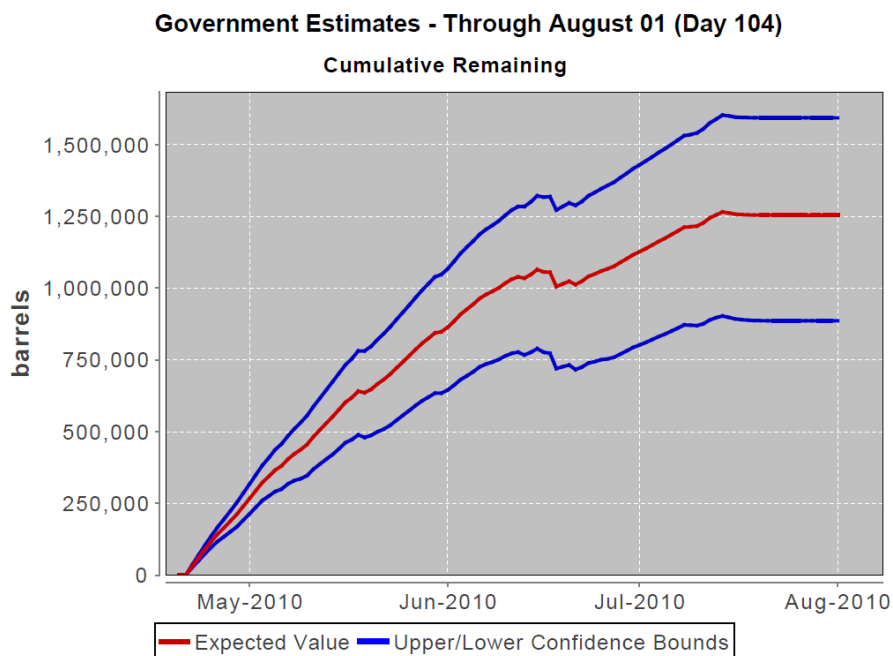
<sup>104</sup> White House Press Briefing, Robert Gibbs, Admiral Thad Allen, Carol Browner, and NOAA Administrator Jane Lubchenco, Washington, D.C. (Aug. 4, 2010), <http://www.whitehouse.gov/the-press-office/press-briefing-press-secretary-robert-gibbs-admiral-thad-allen-carol-browner-and-dr>. To reach 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 106-07.

<sup>105</sup> 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.”).

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 still in 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 report’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, 2010 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.”<sup>106</sup> On the other hand, oil that the budget classified as “remaining” is

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<sup>106</sup> 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\\_email](http://www.mcclatchydc.com/2010/09/15/100645/noaa-head-scientists-work-on-gulf.html?storylink=MI_email). Similarly, when testifying before the Commission on August 25, 2010, 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

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.”<sup>107</sup> But because the Oil Budget did not provide sources or data to support this claim, 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;<sup>108</sup> and on the claim that the oil was “biodegrading quickly.”<sup>109</sup> Scientists argued that the report painted a misleadingly optimistic picture of the situation in the Gulf, presenting uncertain information as fact.<sup>110</sup>

The criticism that the 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.”<sup>111</sup> 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.<sup>112</sup> Indeed, it is unclear whether any of the independent scientists actually reviewed the final report prior to its

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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>.

<sup>107</sup> 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”).

<sup>108</sup> 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).

<sup>109</sup> 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*.

<sup>110</sup> 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.”).

<sup>111</sup> WHAT HAPPENED TO THE OIL?

<sup>112</sup> 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](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>.

release.<sup>113</sup> 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.”<sup>114</sup>

The Administration has declined to make public the data underlying the Oil Budget before publication of a comprehensive report in mid-October.<sup>115</sup>

#### **D. Subsequent Scientific Research**

Scientific reports on the fate of the oil from the Macondo well have begun to emerge over the past two months. Some research has already 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.<sup>116</sup> 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, 2010—focused on the discovery of an underwater plume of hydrocarbons.<sup>117</sup> While conducting research in the Gulf of Mexico between June 19 and 28, 2010, 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.<sup>118</sup> 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.<sup>119</sup>

The release of this study attracted considerable media attention, with many outlets focusing on whether it supported the conclusions of the Oil Budget.<sup>120</sup> The authors of the study have tried to curtail this line of inquiry, describing the 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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<sup>113</sup> *Id.*

<sup>114</sup> Sheppard, *NOAA’s Supposed Peer Reviewers: We Never Reviewed the Report*.

<sup>115</sup> Interviews with government officials.

<sup>116</sup> 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).

<sup>117</sup> Richard Camilli et al., *Tracking Hydrocarbon Plume Transport and Biodegradation at Deepwater Horizon*, SCIENCE EXPRESS, at 1 (Aug. 19, 2010).

<sup>118</sup> *Id.* at 2.

<sup>119</sup> *Id.* at 3.

<sup>120</sup> 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.”<sup>121</sup> 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.<sup>122</sup> The Hazen team, researchers from Lawrence Berkeley National Laboratory, conducted their fieldwork between May 25, 2010 and June 2, 2010. 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.”<sup>123</sup> While the Hazen team’s research suggests more rapid biodegradation, both Hazen and Camilli have described their studies as complementary rather than conflicting.<sup>124</sup> Both found deep sea plumes of hydrocarbons, with Hazen using different, more varied methods to estimate biodegradation.<sup>125</sup>

A third study related to biodegradation was produced by the National Incident Command’s Joint Analysis Group on August 16, 2010, and found depressed, but not hypoxic, oxygen levels at the site of the Macondo well.<sup>126</sup> The group’s study, conducted between May 8 and August 9, 2010, 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.<sup>127</sup> 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.<sup>128</sup>

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<sup>121</sup> Reddy, Op-Ed., *How Reporters Mangle Science on Gulf Oil*.

<sup>122</sup> Terry C. Hazen et al., *Deep-Sea Oil Plume Enriches Indigenous Oil-Degrading Bacteria*, SCIENCE EXPRESS (Aug. 24, 2010).

<sup>123</sup> *Id.*

<sup>124</sup> Deborah Zabarenko, *Microbes Ate BP Oil Deep-Water Plume: Study*, REUTERS (Aug. 24, 2010), <http://www.reuters.com/article/idUSTRE67N5CC20100824>.

<sup>125</sup> *Id.*

<sup>126</sup> 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](http://ecowatch.ncddc.noaa.gov/JAG/files/JAG_Oxygen_Report%20FINAL%20090410.pdf). Hypoxic oxygen levels lead to insufficient oxygenation of surrounding organisms’ blood.

<sup>127</sup> *Id.* at 7.

<sup>128</sup> *Id.* at 8.

### 3. The Fate of All Hydrocarbons

The most recent peer-reviewed paper on the subject, *Propane Respiration Jump-Starts Microbial Response to a Deep Oil Spill*, was published on September 16, 2010 by Valentine, et al. and focused on the fate of all hydrocarbons rather than just oil.<sup>129</sup> Conducted from June 11-21, 2010, 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.<sup>130</sup> 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.<sup>131</sup>

### 4. Current Research

In addition to these published studies, the media has reported on a number of ongoing field studies and their preliminary findings. Dr. Samantha Joye, a professor of Marine Sciences at the University of Georgia,<sup>132</sup> is currently taking sediment samples in the Gulf of Mexico and has found a layer of oily substance up to two inches thick covering the ocean floor in the region of the Macondo well.<sup>133</sup> Dr. Joye thinks the layer is fresh because recently deceased shrimp, worms, and other sea life lie below it.<sup>134</sup> While Dr. Joye has yet to confirm that the oil comes from the Macondo well, she has voiced her belief that what she found is likely dispersed subsurface oil from the spill.<sup>135</sup>

Similarly, a team from the University of South Florida (USF) found oil droplets in marine sediment in the DeSoto Canyon, an underwater fissure that runs from the Macondo site towards

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<sup>129</sup> David L. Valentine et al., *Propane Respiration Jump-Starts Microbial Response to a Deep Oil Spill*, SCIENCE EXPRESS (Sept. 16, 2010).

<sup>130</sup> *Id.*

<sup>131</sup> *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).

<sup>132</sup> 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, 2010. 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](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/>.

<sup>133</sup> 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/>.

<sup>134</sup> Harris, *Scientists Find Thick Layer Of Oil On Seafloor*.

<sup>135</sup> *Id.*; Burdeau and Bornstein, *Where's the Oil? On the Gulf Floor, Scientists Say*.

the coast of Florida.<sup>136</sup> Although this research took place from August 6-16, 2010, the researchers have not confirmed that the droplets are from the Macondo well.<sup>137</sup> One of the researchers involved has noted that their findings are preliminary and should not “get misconstrued as scientific fact.”<sup>138</sup>

Dr. Joye and the USF team appear to be publicizing their work in part to highlight that the oil spilled is not gone.<sup>139</sup> Perhaps to some extent as a consequence of these early findings, government officials have changed the tone of their public statements on the fate of the oil. For example, on September 15, 2010, Administrator Lubchenco acknowledged that oil is being found on the seafloor and promised that the government “will 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.”<sup>140</sup> Pursuant to Admiral Allen’s August 13, 2010 directive, NOAA is now leading an extensive study, which includes independent and government scientists, to better understand how much oil remains in the Gulf and its impacts on the marine ecosystem.<sup>141</sup>

### **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.
- As with the Flow Rate Technical Group, the Commission may wish to consider recommending that government scientific study groups disclose more of their underlying methodologies, assumptions, and data, allowing for greater review and input from the rest of the scientific community.

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<sup>136</sup> Vickie Chachere, *USF Scientists Detect Oil on Seafloor*, UNIVERSITY OF FLORIDA NEWS SERVICE (Aug. 17, 2010), <http://usfweb3.usf.edu/absoluteNM/templates/?a=2604&z=120>.

<sup>137</sup> *Id.*

<sup>138</sup> Christine Dell’Amore, *Toxic Oil Found Deep on Gulf Seafloor?*, NATIONAL GEOGRAPHIC DAILY NEWS, Aug. 18, 2010, <http://news.nationalgeographic.com/news/2010/08/100818-gulf-oil-spill-seafloor-toxic-science-environment/>.

<sup>139</sup> Burdeau and Bornstein, *Where’s the Oil? On the Gulf Floor, Scientists Say*.

<sup>140</sup> Press Briefing and Teleconference, Admiral Thad Allen and NOAA Administrator Dr. Jane Lubchenco (Sept. 15, 2010), <http://www.piersystem.com/go/doc/2931/898775>.

<sup>141</sup> 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).

- The fate and impacts of oil released from the Macondo well are unlikely to be resolved before the Commission issues its report. The Subcommittee on Restoration: Impacts and Assessment will follow emerging scientific findings and take up these important issues.

## Appendix

