National Weather Service

Operations and Workforce Analysis

Unleashing NWS's potential to protect lives and property by providing actionable information to critical decision-makers

Draft for discussion | September 2016

Intended for Internal NWS Leadership / NOAA Audience

PRE-DECISIONAL & CONFIDENTIAL

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Executive summary

This document details the findings, ideas, and actions generated by the OWA project from May 2015 to August 2016. This document is intended for use internal to NOAA and the National Weather Service, and is not intended for distribution beyond senior leadership. Key findings and ideas are captured in Exhibit 1 below.

Exhibit 1: Summary of Findings & Ideas

	Finding	**Ideas**
Workforce	There is a mismatch in some areas between workforce and workload	■ Strategically staff offices based on criteria that estimate workload
	There is a difference between current and desired skill level for IDSS	■ Develop NWS 101 onboarding program ■ Improve workforce training ■ Introduce internal rotation programs ■ Revisit federal qualification standards for key positions
	GS5-11 meteorologists are not fully developed and utilized in WFOs, and promotion to GS12 is inefficient	■ Create a GS5-12 career progression
Operating model	IDSS is delivered inconsistently and to varying degrees today, including who receives service and how they receive service	■ Establish core and deep partner segmentation ■ Establish standard service levels for IDSS ■ Build reporting, accountability, and coaching mechanisms to support all MICs/HICs in achieving standard service levels
	The forecast process has some duplication of effort, does not make best use of local staff time, and can result in inconsistent forecasts	■ Develop a collaborative forecast process using National Blend of Models as single starting point ■ Produce gridded forecasts for larger CWAs where appropriate
Organizational structure	There is a lack of role clarity between the newly reorganized National Service Programs (NSPs) and the National Centers for Environmental Prediction (NCEP), as well as	■ Improve NSP program role clarity ■ Develop common NCEP operating model

	inconsistencies in NCEP roles and responsibilities	
Organizational structure	Tsunami Warning Centers are not aligned to partner needs	▪ Align Tsunami Warning Centers operationally and consider broader changes to program delivery
	There is a lack of role clarity between River Forecast Centers (RFCs) and the Office of Water Prediction/National Water Center (OWP/NWC)	▪ Clearly define roles for RFCs and OWP/NWC in the forecast process and IDSS ▪ Re-evaluate reporting structure of RFCs
	Staff in WFOs do not have sufficient time or flexibility to deliver IDSS due to current responsibilities, cookie-cutter staffing, 24/7 requirement, and requirement of 2 people per shift	▪ Unlock time for strategic staffing through function and form changes
	Some current WFO functions are not most effectively delivered within an individual office	▪ Establish formal mechanisms for offices to support each other
	Span of control for field managers is high	▪ Develop additional supervisory positions
	NWS's organizational health is not sufficient to support performance	▪ Focus on priority practices such as role clarity, capturing external ideas (innovation), and creating an open and trusting environment
Fully Integrated Field Structure	The findings on workforce, operating model, and organizational structure indicate that the current distribution of staff across the country can evolve to better serve partner needs	▪ Apply the strategic staffing blueprint given ideas on roles and responsibilities to re-align staff to match workload

Background: NWS is at a critical inflection point

In the past 30 years, NWS's forecast and warning capabilities have progressed dramatically, NWS partners have become more sophisticated, and the private weather enterprise is more active than ever. Yet lives and property are still lost due to weather events, with an estimated 550 deaths[1] and an average of five billion-dollar damage events each year, with hurricanes inflicting an average of $16 billion in damage per event[2]. As an example, approximately the same number of lives were lost in the recent 2011 tornado outbreak as were lost in the 1974 tornado outbreak – over 300 in each case – despite almost a week's notice that an outbreak was likely and over 20 minutes of lead time before tornadoes hit[3]. Given the fact that the number of weather, water, and climate events that result in significant damage are expected to continue to increase[4], NWS and many stakeholders realize that achieving NWS's mission of protecting lives and property requires more than the best science, it also requires delivery of improved service to government partners, through actionable information that supports decision making to protect lives and property. NOAA and NWS defined this new vision in NOAA's 2013 strategic plan as building a "Weather-Ready Nation," one that is ready, responsive, and resilient to extreme weather, water, and climate events[5]. Enhancing Impact-based Decision Support Services (IDSS) to partners is a centerpiece of building a Weather-Ready Nation.

While stakeholders expressed support for this vision, NWS also heard calls from organizations, including the National Academy of Public Administration (NAPA) and National Academy of Sciences (NAS), to go further to address gaps in capabilities, work collaboratively with internal and external partners, and rethink its organizational structure and alignment of resources[6]. Similarly, NWS employees, via the annual Federal Employee Viewpoint Survey (FEVS), have asked for change to improve organizational health and culture.

Moreover, while NWS continues to be foundational to the broader weather enterprise, major developments in private sector capabilities mean that NWS has an opportunity to reassess its role in the enterprise, making sure its resources are being used in the most effective and efficient way to support government's core function: protecting the public and enhancing the public good. NWS and NOAA believe service to government partners and organizations with public safety missions is an inherently governmental function. While the private sector is increasingly moving into decision-support service models, they are doing so with revenue and cost opportunities as the main factors, not primarily to protect lives or property.

[1] http://www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf

[2] http://www.ncdc.noaa.gov/billions/summary-stats

[3] National Weather Service, Service Assessment: Historic Tornados of April 2011

[4] U.S. Global Change Research Program, Our Changing Planet: The U.S. Global Change Research Program for Fiscal Year 2016

[5] NOAA, "NOAA's National Weather Service Strategic Plan: Building a Weather-Ready Nation", June 2011

[6] National Association of Public Administration, Forecast for the Future: Assuring the Capacity of the National Weather Service, 2013

Project Overview: NWS launched the Operations and Workforce Analysis (OWA) project to chart a path forward

In light of the need for NWS to deliver on the Weather-Ready Nation vision and address the challenges associated with the nation's increasing vulnerability to extreme weather, water, and climate events, account for stakeholder calls for change, and capitalize on the growth of new technologies in the changing external environment, NWS launched the Operations and Workforce Analysis (OWA) project in May 2015. The objectives of the OWA project build towards achieving a Weather-Ready Nation vision, and include an assessment of the value of IDSS to partners and to the mission.

The OWA project had the following objectives:

1. **Stakeholder Engagement and Change Management:** Develop the capacity to involve stakeholders throughout the project
2. **Current State Baseline:** Understand and baseline current state operations and workforce model through a comprehensive assessment and analysis
3. **Evaluation of IDSS:** Better qualify and quantify IDSS across the entire organization (it will vary geographically and organizationally), and account for the varied nature of IDSS as it applies to weather, water, and climate events
4. **Current State Gaps:** Identify gaps in the current state operations, workforce, and organization required to support IDSS and achieve a Weather-Ready Nation
5. **Recommendation of Alternatives:** Develop recommendation(s) for evolving NWS from current to future state to close gaps, leverage state-of-the-art science and technology, consider geographic differences and enable services and workforce concepts in NWS strategic documents
6. **Implementation Planning:** Advance recommendations to action through plans, quick wins, and phased implementation

OWA involved several phases: 1) an independent, fact-based diagnostic across NWS's workforce, operating model, and organizational structure, 2) identification of ideas to address the diagnostic, 3) refinement of ideas and alignment on a vision, led by employees from headquarters and the field and involving stakeholders, as well as development of "quick wins", and 4) development of testing and evaluation plans, similarly led by NWS and involving stakeholders, to lead to implementation.

NWS leadership undertook the OWA project with the following considerations regarding scope:

- Ensure no adverse impact to the NWS's mission core mission of saving lives and enhancing the nation's economy
- Provide appropriate transparency and engagement
- Account for changing demographics and unique/regional challenges
- Leverage analysis and recommendations from previous studies

- Bottom-line reductions in workforce are not a driving factor and should not be a main consideration
- Assess infrastructure/facilities implications without seeking office closures, including colocations with partners where opportunities arise
- Project future science and technology changes as a factor in recommendations, especially as they relate to delivering forecasts and warnings to decision-makers

Methodology: The methodology for OWA is rigorous, fact-based, and inclusive, involving employees and stakeholders

The methodology for OWA included multiple sources of insight. The Phase 1 OWA diagnostic was an independent review of NWS's ability to deliver on a Weather-Ready Nation through IDSS, across its workforce model, operating model, and organizational structure, and included the following:

- **Data collection.** Data were collected from NWS's Office of the Chief Information Officer (CIO), NWS's Office of the Chief Financial Officer (CFO), and NOAA's Workforce Management Office (WFMO) on historical and current vacancies and positions breakdown, retirement eligibility and tenure, and hours (regular and overtime) worked. Additional data were collected on office characteristics (e.g., area of responsibility, responsibilities for terminal aerodrome forecasts (TAF)), watches, warning, and advisories (WWA) and weather event data by office. Data were also collected on the skills needed for meteorologists through interviews and an MIC survey.
- **Surveys.** Three diagnostic surveys were conducted:
  - The Organizational Health Index (OHI) survey, with internal staff. The OHI survey was voluntary, went to all NWS staff, and achieved a 49% response rate.
  - IDSS Stakeholder survey, sent in 2015 through Warning Coordination Meteorologists (WCMs) to stakeholders and received over 700 responses.
- **Site visits and job shadowing.** Forty-two offices (see Appendix) were visited during the diagnostic, representing 20 different locations across the six regions that comprise the NWS's coverage map for the United States. Site visits were selected based on objective criteria. First, a list of all NWS offices was generated including data on office type (e.g., Weather Field Offices (WFOs), River Forecast Centers (RFCs), Regional HQs, Center Weather Service Units (CWSUs), marine- versus land-based coverage, and population density). Second, locations were randomized to be representative across the above criteria in order to ensure at least two visits, per region, in the Continental US and at least one visit in the Pacific/Alaska region. Then, a national perspective was taken to consider NCEP locations and other factors (e.g., types of weather events, such as fire weather, as well as IDSS needs).
- **Interviews and focus groups.** More than 560 internal and external stakeholders were interviewed through one-on-one discussions, as well as focus

groups, during the diagnostic. These included ~360 internal staff and ~200 external stakeholders.

Subsequent phases (phases 2 and 3) including idea generation, refinement and development of plans were conducted through an inclusive process with significant internal and external engagement on ideas. The process of aligning on vision, developing ideas, and planning for testing and evaluation included:

- **Core team weekly meetings and workshops:** Five core teams consisting of ~10 NWS employees each were established against each topic area identified in the diagnostic to develop ideas, address findings and advance actionable ideas. The teams, led by members of the NWS Office of Organizational Excellence (OOE) or field managers (e.g., managers of local offices), held weekly conference calls, interviewed subject matter experts, consulted senior leadership, and held in-person workshops.
- **Field Director weekly meetings and workshops:** Given the sensitive nature of work developing ideas for the staffing model and organizational structure, OWA developed a team comprised of the six Regional Directors, the NCEP Director, the Acting National Water Center Director, and the Chief Operating Officer, called the "Strategic Staffing" team. Several regional leaders (e.g., Deputy Directors, Science branch chiefs) and field managers (e.g., MICs, HICs) acted as Subject Matter Experts (SMEs) to the Strategic Staffing team. The Strategic Staffing team met weekly for virtual working sessions and held multi-day, in-person workshops to develop and refine ideas.
- **Operations & Workforce Committee (OWC) Meetings:** Monthly meetings of the OWA's governance body, the OWC, were held to establish the scope of possible solutions, test and refine ideas, integrate ideas across portfolios and parts of the operation, and provide guidance on team plans.
- **OWC Executive Champions:** Senior leaders from across NWS played an active role in the identification and refinement of fully integrated field structure ideas through five OWC meetings, and weekly updates with the Deputy Associate Administrator.
- **NWSEO leadership engagement:** The OWA informed NWSEO of key design principles of a fully integrated field structure early in the process.
- **External stakeholder engagement:** OWA informed external stakeholders (e.g., NWA, appropriations committee) of key design principles of a fully integrated field structure early in the process.
- **Analytical tools:** The OWA developed a workforce model to determine labor cost and staffing implications of fully integrated field structure ideas using historical and current data from the CFO and WFMO. The model uses the latest data from the Table of Organization, vacancy reports, and the CFO's AREV cost estimation tool to create a comprehensive picture of the current state by position, series, and grade for every field office, estimating the field cost to 98% of the actual cost. Design options such as staffing composition across offices can be tested through the use of this tool.

- **Management surveys.** Surveys were sent to NWS managers (i.e., leaders of WFOs, NCEP Centers, CWSUs, and RFCs) to gather data on the current state and their perspective on design choices relating to the workforce model and operating model. Three surveys were sent on the following topics: 1) Meteorologist development model, 2) the WFO operating model (shift duties, scheduling), and 3) Meteorologist skills needed.
- Partner surveys. A Customer Experience (CX) survey was sent to over 1,500 NWS partners in 2016 which achieved a 38% completion rate. The majority of partners surveyed were EMs, but DOT, Water, Aviation, FEMA, Media and Other partners were also included and made up 32% of the survey respondents.

Change management approach to design

Given the NAPA findings around the need to build NWS's change management capabilities so that it can continue to innovate and evolve in the future, as well as the OHI findings on the lack of trust between management and staff[7], the OWA project determined a change management approach could best position the organization for lasting impact. Importantly, this decision meant involving internal and external stakeholders throughout the process, and focusing on ideas that could garner enough support to be acted upon.

To that end, the design process sought to address diagnostic findings while balancing the potential impact of ideas with their feasibility. The OWA project did not seek to design a "clean-sheet" field structure in the interest of feasibility and the imperative to pursue change quickly, due to financial, labor, and political considerations. The design process also worked within the solution space described by Options 2-4 in Exhibit 2.

Exhibit 2: Design options

Resulting change to current org structure

Less change from today → More change

	1. Status quo	2. Varied offices	3. Optimized current locations	4. IDSS service outlets	5. Clean sheet locations[1]	6. Deployed field support	7. Data provider field offices
A WHAT functions performed in field offices *(vs NCEP, Region, HQ)*	▪ **No change** to current functions	▪ Optional change to forecasting ▪ **Workload dependent on IDSS and obs network**	▪ Optional change to forecasting ▪ **IDSS focused on key core partners**	▪ Centralized forecasting ▪ **Field focuses on IDSS provision**	▪ Optional change to forecasting ▪ **IDSS focused on key core partners**	▪ Centralized forecasting ▪ IDSS focused on **network of core partners**	▪ Centralized forecasting ▪ No field focus on IDSS ▪ **Focus on obs collection & maintenance**
B WHO performs these functions *(e.g, skills and roles in field)*	▪ No change	▪ **Change to who:** Field offices differ in size and potentially in skill mix to focus on local workload	▪ Potential change to WHO	▪ **Change to who:** Skills and roles change to focus on IDSS skills and roles	▪ Potential change to WHO	▪ Potential change to WHO	▪ **Change to who:** Roles focus on excellence of provided data and maintaining obs network
C WHERE located to perform functions *(e.g., in person, deployed)*	▪ No change	▪ Potential change to WHERE	▪ **Change to where:** IDSS embedded; responsibilities across CWAs combined	▪ Potential change to WHERE	▪ **Change to where:** Functions dictate where NWS is in the field without accounting for current locations	▪ **Change to where:** Functions performed by deployed field support staff	▪ Potential change to WHERE
Potential Impact to current field org structure	▪ Function of field office does not change substantially from current field office	▪ Each field office varies to accommodate current workload variance in its community	▪ Offices change to solve for overlaps in responsibilities and increase consistency	▪ Offices change in order to primarily act as IDSS providers and disseminators of information for other offices	▪ Offices are ideally located across NWS to have balanced workload and to be able to reach correct partners	▪ Field flexible to needs of stakeholder and can adapt to future changes to technology	▪ National Weather Service should focus on remaining pre-eminent source of data

1 Clean sheet refers to the starting point of a blank or clean sheet in which existing locations are not considered

7 National Association of Public Administration, Forecast for the Future: Assuring the Capacity of the National Weather Service, 2013

The OWC governance body voted as a “Key Decision Point” to pursue on Options 2-4 in Exhibit 2 after consultation with stakeholders, risk assessments, and discussions with customers on needs. Local presence, in particular, was a critical part of the Weather-Ready Nation vision and requests from Emergency Management partners. Moreover, a “clean sheet” assessment was deemed impractical given high fixed costs of infrastructure and technology, length of time and complexity that would be required, and resources available for facilities in the near term, though strategic positioning of some physical locations (such as collocating with academic/research facilities or Emergency Management partners at the local, state, and national level) was left open for consideration.

The diagnostic identified several challenges

Summary

The diagnostic of the Operations and Workforce Analysis (OWA) was launched to establish a baseline understanding of the National Weather Service (NWS). The goal of the diagnostic was to develop a current state baseline and assessment of any gaps in the areas of workforce, operating model, and organizational structure required to deliver Impact-based Decision Support Services (IDSS) and achieve a Weather-Ready Nation.

The current operating model and field structure was designed around radar technology and technology of the 1990s, when the NWS last modernized. As a result, NWS designed each office, one per radar site, to be independently self-sustaining. Today, NWS has significantly more information available, both in terms of extended-range forecasting and short-term situational awareness, and communications technology that allows staff to work collaboratively across the country. NWS also has enhanced its focus on serving partners, yet the workforce, operating model, and organizational structure have not been designed with NWS's partners in mind.

Findings across workforce, operating model, and organizational structure highlight the challenges NWS has meeting its mission, including the demands of delivering IDSS. Many of the findings suggest that the current workforce is not positioned to spend time on the highest value activities. In some cases there are inefficiencies from the organization delivering lower-value activities that could be automated or performed by fewer staff. Additionally, staff are not distributed according to workload, both across offices and shifts.

The summarized findings are as follows:

- **Workforce.** Controlling for differences, there is a mismatch in some areas between today's workforce and today's workload. In addition, there is a difference between the current and desired skill level for skills identified as important to IDSS, including written and oral communications.
- **Operating Model.** Core partners strongly trust and rely on the NWS, and multiple examples of IDSS were observed as well as generally high customer satisfaction. However, there are a number of definitions of IDSS, including in terms of what IDSS products are provided, how IDSS is delivered, when IDSS is delivered and to whom IDSS is being delivered. The forecast process contains some duplication of effort, low-value add time, and can lead to inconsistencies between forecast shifts, across local offices, and between national and local offices.
- **Organizational Structure.** The current field structure, particularly how NWS employees and resources are located across the country, does not best support the IDSS operating model. The roles and responsibilities of field offices require additional clarity, particularly where there is overlap. Within WFOs, staff time is not being spent on the highest value activities due to the current responsibilities assigned to meteorologists. Additionally, while the local reach of NWS field offices supports the IDSS operating model, there are some functions that could

be more effectively and efficiently delivered across multiple WFOs (e.g., gridded forecast production, “met watch” in some cases, warnings in some cases). Within many offices, the span of control for field managers is too high to manage in the new service delivery model. Moreover, the proprietary Organizational Health Index (OHI) survey completed by ~50% of NWS staff, including NWSEO members, revealed that NWS has overall lower health scores, including in innovation and learning and coordination and control. Strengths in motivation and external orientation were identified.

As such, NWS has an opportunity to address the challenges across its workforce, operating model, and organizational structure to deliver on the vision for Weather-Ready Nation and best protect lives and property.

FINDINGS ON NWS’S WORKFORCE

Summary: Controlling for differences, there is a mismatch in some areas between today’s workforce and today’s workload. In addition, there is a difference between the current and desired skill level for skills identified as important to IDSS, including written and oral communications.

There is a mismatch in some areas between workforce and workload

Current and future workforce supply

Currently, the NWS workforce is highly dispersed with the majority of staff (82%) working within one of the 183 field offices. The NWS average vacancy rate is 8% of appropriated for positions. The largest number of vacancies are occurring in the field, and the highest percent of vacancies are occurring in headquarters. While vacancy rates do vary by position, the highest absolute number of vacancies occur in meteorology roles, but the rates of vacancies are higher in non-meteorological positions. Vacancies in RFCs are similar across both support and hydrology positions, while at headquarters, many of the vacancies are in support positions.

There are two key drivers of changes in the workforce supply for NWS: 1) External hiring increases the NWS workforce, while attrition and retirement lead to workforce decreases; and 2) Reduced hiring rates and increased attrition in recent years have led vacancies to increase even as the number of FTEs has remained relatively constant over time. While hiring rates have increased in the past two years, significant hiring challenges and high retirement eligibility pose potential challenges in the future (Appendix, Workforce findings).

An increased hiring rate, following the trend of the last two years, could offset attrition losses beginning in 2020. However, even with increased hiring rates, vacancies will likely continue to persist. If the hiring rate were to remain at its current level, then vacancies could continue to increase through 2025.

The current career path for most NWS meteorologists starts in the intern position, though there are not currently enough interns in the NWS to fill the vacancies and expected attrition in the journeyman forecaster positions. In addition, past hiring freezes, coupled with the time required to develop senior meteorologists and hydrologists, have contributed to a potential leadership gap. There are additional challenges in career paths for hydrologists and hydrometeorological technicians due in part to the fact that both positions usually share a common hiring process with forecaster positions.

Current and future workload demand

In order to understand the distribution of NWS's workforce versus expected NWS workload, OWA estimated expected workload using a set of independent drivers, including severe weather events, the population and area of responsibilities served, IDSS expectations, programs managed by the offices, and others. It is important to note that WFO workload drivers are not independently correlated to workload in offices. Many workload drivers have varied between 2008 and 2014 with no significant patterns related to workload data emerging in that time period. Individual occurrences of severe weather events alone do not directly correlate with a WFO's workload, even when accounting for office size. Existing data does not currently measure the duration of individual severe weather events, as frequent long-tail adverse weather events could disproportionally increase workload relative to other offices.

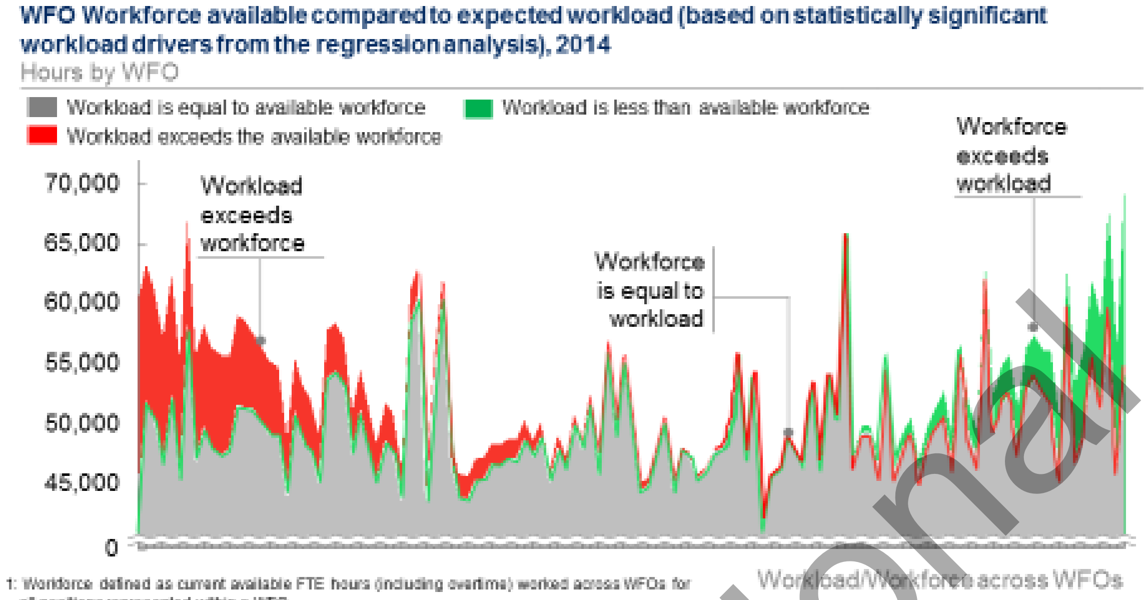
There is also a varying level of overtime by year, but WFOs have the highest amount of overtime by hours. CWSUs and RFCs have varying levels of overtime from office to office. In terms of total workload, there is not a wide variation between offices in total hours worked per FTE, and this has remained relatively constant over time. NCEP total workload includes relatively low overtime and has not varied over time.

Mismatch between workforce and workload

The diagnostic analysis projected the difference between the workforce (hours actually worked) and expected workload (based on workload drivers described) for WFOs from 2008 to 2014. The regression analysis included a set of statistically significant workload drivers. The model achieved statistical significance with an f-statistic of 32.02 with a confidence interval of greater than 99% as well as an r-squared value of .5392. It indicated that a gap exists between today's expected workload and today's workforce (e.g., actual hours worked including overtime) that varies by WFO.

The difference varies across WFOs, with the regression projecting a higher expected workload than actual hours worked for some WFOs, while it projects a lower expected workload than actual hours worked for others. Severe weather and additional IDSS could exacerbate this gap in both cases. The type of office with a high expected workload also varied depending on the type of work included in the model, and whether the hours were for the entire office or just for Series 1340 meteorologists. Because of the variance in the ways different positions are used in offices, there are further limitations in the utility of comparing across offices using just the series 1340 meteorologist hours.

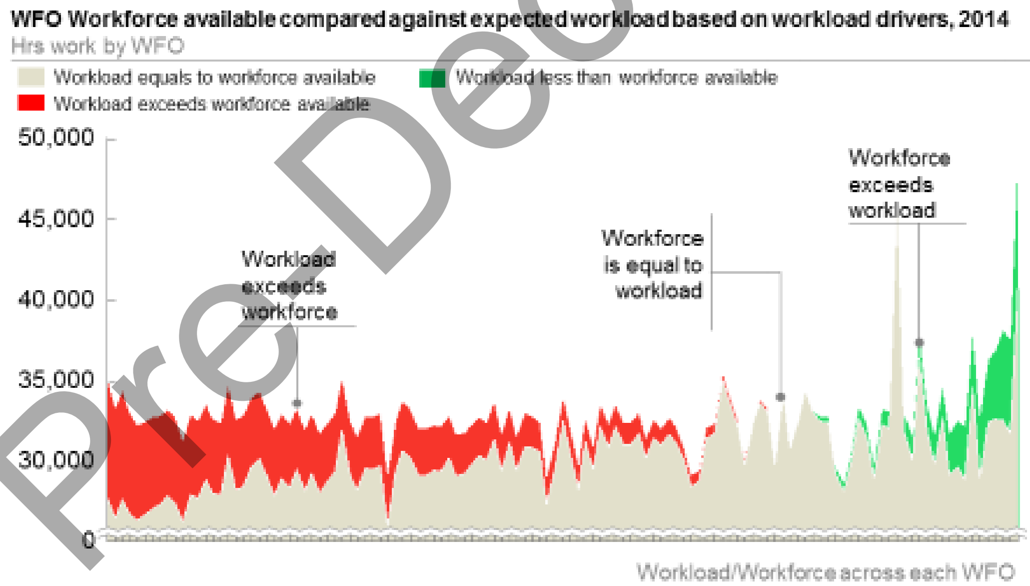
Exhibit 3: WFO workload analysis



1: Workforce defined as current available FTE hours (including overtime) worked across WFOs for all positions represented within a WFO
2: Workload defined as expected workload based on team regression analysis accounting for variance in workload drivers

When the analysis was conducted using only 1340 meteorologist hours, there was an increase in the number of offices with a deficit of workforce to anticipated workload.

Exhibit 4: 1340 Workforce analysis



1 Regression analysis returned statistically significant results with p-value of 0.00 and overall lower r-squared of .2444; variables that were not statistically significant in this regression but were significant in the full regression were population, pop. density, land area of responsibility, advisories, and the Western and pacific region dummy variables; variables that became statistically significant were the number of fire, tropical and marine events; and the eastern and Alaskan region dummy variables
2 Workforce defined as all FTE and overtime hours worked by series 1340 FTEs, which would include and supervisory positions in series 1304

There is a difference between current and desired skill level for IDSS

In a skill assessment, supervisors indicated skill gaps exist in the written and oral communications skills required to perform IDSS. The full skill assessment revealed gaps in skills especially for those identified as important to IDSS and for the intern position. A talent systems assessment also highlighted strengths in capabilities and talent pools for key roles, but opportunities for improvement in the areas of workforce planning, hiring, performance management and training.

Exhibit 5: IDSS skill gap

Outcome scores based on MIC evaluation of current and desired skill level

Skills	Importance to IDSS[1]	Gap between current and desired scores, rounded: Forecaster	WCM	Intern	HMT
Problem solving	4.4	0	1	2	1
Applying weather science	4.4	1	0	2	1
Data collection	4.2	0	-1	2	0
Analytics and stats	4.4	1	0	2	1
Computer and IT tech	4.8	1	0	2	0.5
Customer service	3.6	2	1	3	0.5
Leveraging diversity	3.8	2	1	1	0
Quality focus	4.2	0	0	2	1
Teamwork	3.6	2	2	2	1
Creative thinking	4.4	1	2	2	0
Judgment/decision-making	4	1	1	2	0.5
Leadership	4.4	2	2	1	1.5
Partnering	4.4	2	0	2	1
Written communications	4.6	3	1	2	1
Oral communications	4.6	3	2	1	1
Coordination	4.2	2	0	2	1
Information gathering	3.8	1	-1	1	1

GS 5-11 meteorologists are not fully developed and utilized in WFOs, and promotion to GS 12 is inefficient

Meteorologists are currently hired into the NWS through a GS 5-11 1340 Intern position. The Intern position is distinct from the GS 12 1340 Forecaster position both in responsibilities and in career pathway. GS 5-11 meteorologists do not formally perform forecasting and IDSS duties today (although roles vary across offices), rather they run the Public Service Unit, which involves answering general public inquiries, monitoring and managing NOAA Weather Radio messages, launching weather balloons, and quality controlling observations. Increasingly they perform general outreach tasks such as managing social media presence and assisting with preparation for webinars.

In order to become a GS 12 forecaster, Interns must compete for GS 12 positions, which requires additional hiring actions that contribute to the hiring backlog at NWS. In many cases promotion to GS12 requires taking an opening in a different office, which then can incur Permanent Change of Station (PCS) costs.

The disconnect between the GS 5-11 positions and the GS 12 position does not make the best use of the skills of early career meteorologists, contributes to hiring delays, incurs additional expenses, and does not adequately involve GS 5-11 meteorologists in the provision of IDSS.

FINDINGS ON NWS'S OPERATING MODEL

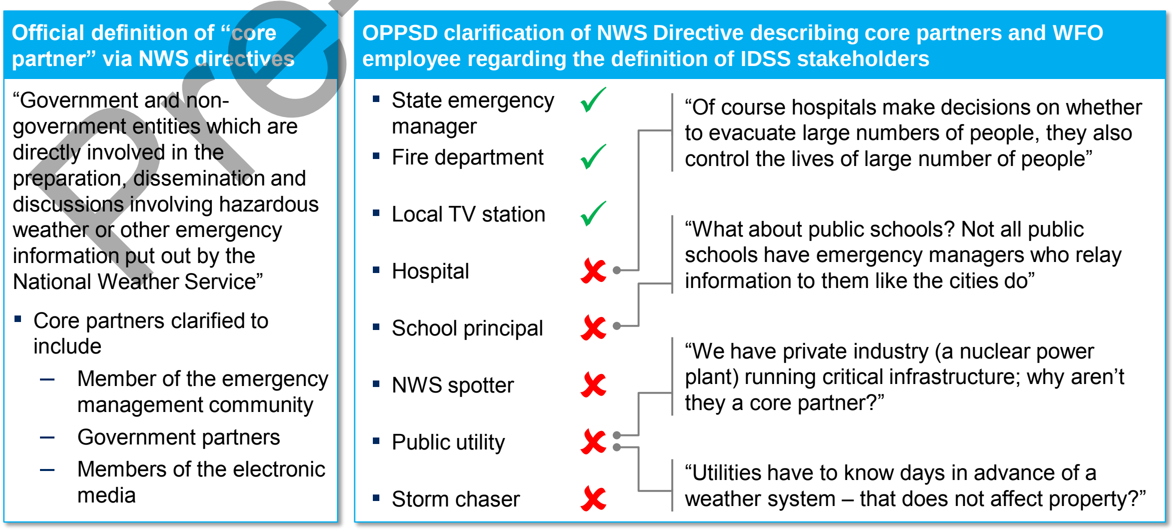
Summary: Core partners strongly trust and rely on NWS and value the IDSS provided today. Many examples of IDSS were observed as well as generally high customer satisfaction. However, there are a number of definitions of IDSS, including in terms of what IDSS products are provided, how IDSS is delivered, when IDSS is delivered and to whom IDSS is being delivered. Additionally, the forecast process contains some duplication of effort and can lead to inconsistencies between forecast shifts, across local offices, and between national and local offices.

IDSS: Who is served

The external stakeholder landscape is composed of several interconnected networks of which the NWS is an important part. This network includes research and academic councils, core partners, media companies, the commercial weather industry, and other external stakeholders such as schools and hospitals. The general public is included as a user of the weather information disseminated from the overall enterprise.

The definition of a "core partner" has been outlined in NWS Policy Directive 1-1003 and includes members of the emergency management community, government partners, and members of the electronic media (assuming they have dissemination capabilities for weather information). Further guidance issued in the Service Description Document in 2014 articulated the stakeholders who are and are not included in the definition of "core partners." However, site visits and interviews indicated that some offices consider stakeholders who are not part of the definition of "core partners" to be critical, including the general public and utilities. This suggests that the existing policy has not yet been fully internalized and operationalized by employees throughout the organization. As such, there is variation in partners served.

Exhibit 6: Variation in core partners served



A review of partners identified by local offices, conducted in May of 2016, revealed that there is wide variation in types and number of partners served. Offices identified anywhere between 100 and 1,000 core and deep partners[8]. Offices in the same state often report serving the same state partners, while interviews with partners suggest that additional coordination is required for supporting partners who work with more than one WFO regularly[9]. WFOs also acknowledged the need for additional guidance on whether to serve certain types of partners (e.g., schools, utilities and infrastructure providers, and public health entities). There is no standard policy across offices, and as such, practice varies widely.

Existing metrics used to evaluate the effectiveness of IDSS products and information include Service Assessments, stakeholder feedback, and Government Performance and Results Act (GPRA) data. Service Assessments often include a strong focus on the outcomes of weather events on life and property, and are often linked closely to the IDSS definition of Weather Ready Nation 2.0. Likewise, stakeholder feedback often focuses on the impact that NWS information had on stakeholder decisions. However, these metrics are difficult to implement systematically for all weather events across the organization because they rely on qualitative feedback and are resource-intensive to develop. On the other hand, GPRA data is collected across the organization but taken alone as a measure of forecast accuracy and utility, which is output-focused and less tied to impact.

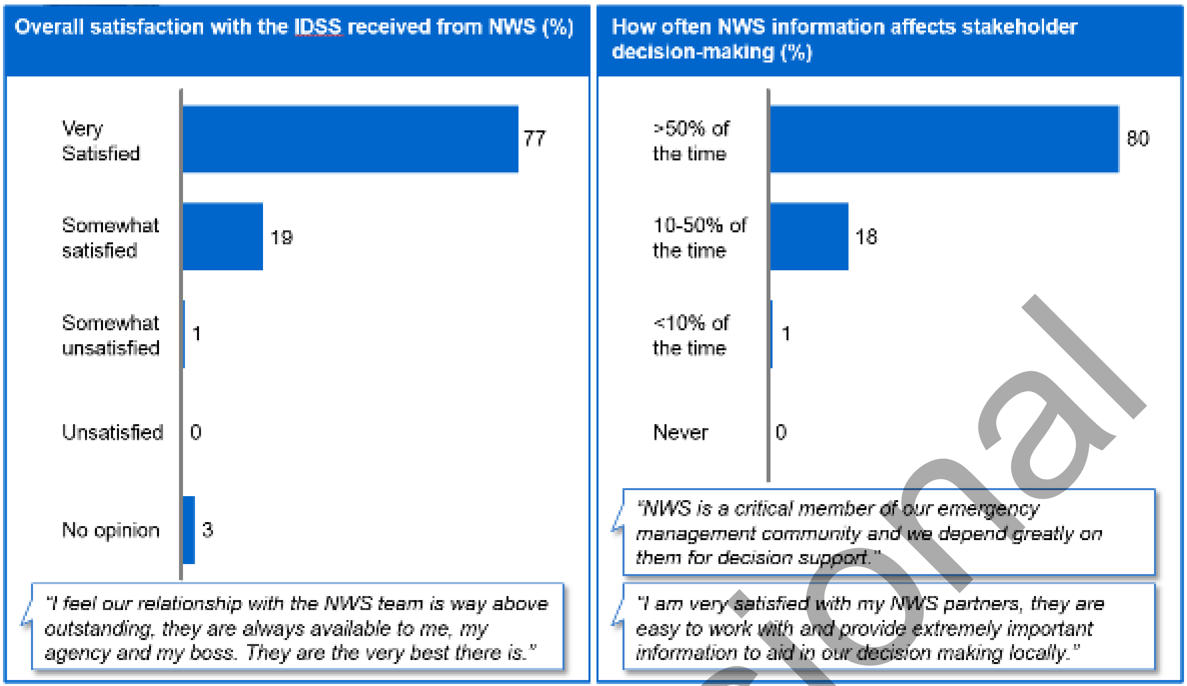
Most partners are very satisfied with the support they receive from the NWS

The vast majority of stakeholders surveyed in 2015 (96%) reported that they were either satisfied or extremely satisfied with the service they receive from the NWS. In addition, 80% of respondents said that the information they receive affects their decision-making.

[8] April 2016 data call to NWS offices, and subsequent follow-up interviews with WFO managers

[9] Interviews with NWS state-level core partners

Exhibit 7: Partners are generally satisfied with NWS



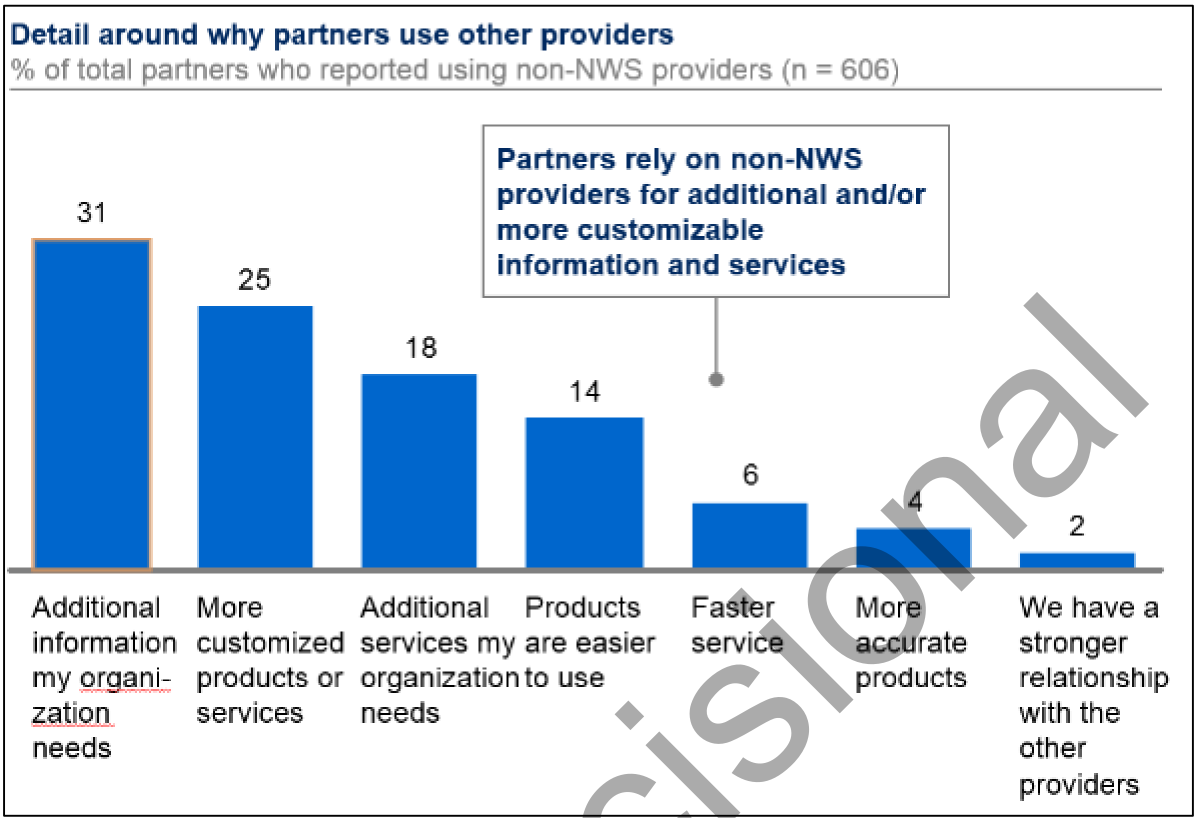
Through the survey and interviews, external stakeholders praised the NWS and highlighted trust, accessibility, accuracy, and relevance as the key themes. The diagnostic found local presence, local knowledge, and local relationships are critical for successful decision support. Staff and partner interviews highlighted the importance of the personal relationship built with WFO staff:

- "Don't send me someone who can't pronounce my county name correctly"
- "…I had two forecasters get sent back from the EOC because the partner didn't know who they were, and wanted to work with staff they knew"

The majority of partners also rely on non-NWS providers for weather information

The customer experience (CX) survey conducted in July 2016 identified that 70% of NWS partners, "used non-NWS provider(s) for additional weather and water products and services". While one would expect that partners rely on multiple providers, the partners' rationale for using additional providers showed that there were gaps in NWS offerings (Exhibit 8). Most partners tended to use non-NWS providers because they offered more information, more customization, or additional services, but some also mentioned that non-NWS providers offered faster service, easier to use products, or more accurate products.

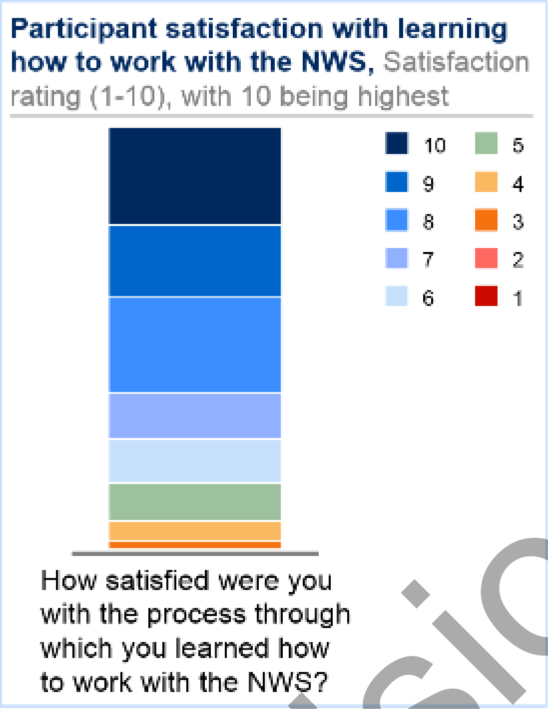
Exhibit 8: Partners used non-NWS providers for a variety of reasons



Partners had varied experiences when initially learning how to work with the NWS

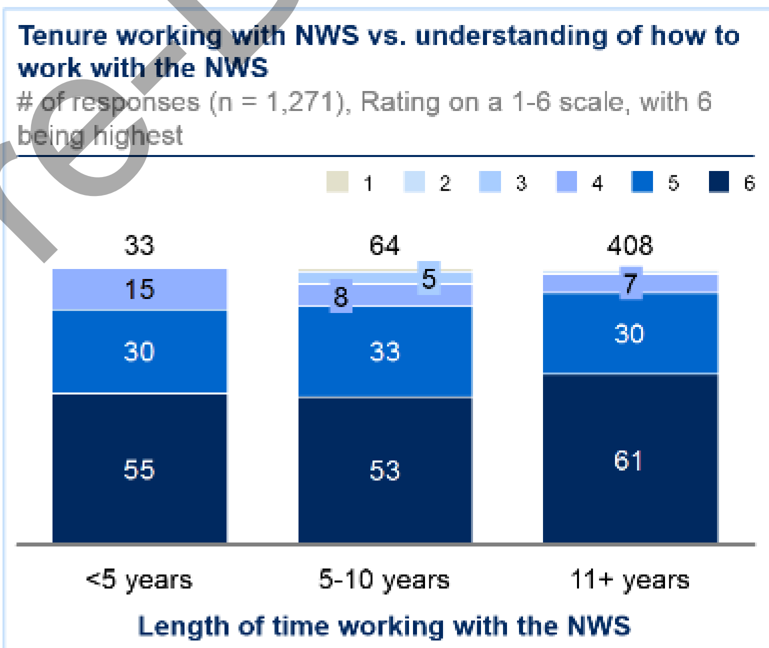
While partners were overall very satisfied with the NWS, there was significant variability around how they learned how to work with the NWS. When asked in the CX Survey, "How satisfied were you with the process through which you learned how to work with the NWS?" about half of partners rated their satisfaction at a 7 (out of 10) or below (Exhibit 9). This data suggest that a more structured onboarding process at the NWS could be beneficial when interacting with new partners or new staff at partner organizations.

Exhibit 9: Partners had a diversity of experiences when learning how to work with the NWS



Additionally, surveying partners indicated that they did not become much more familiar with how to work with the NWS over time (Exhibit 10). Partners with 11+ years of experience working with the NWS showed almost the same levels of understanding of how to work with the NWS as those with 5 years or less of experience.

Exhibit 10: Partners did not become much more familiar with understanding how to work with the NWS over time



IDSS is delivered inconsistently and to varying degrees today

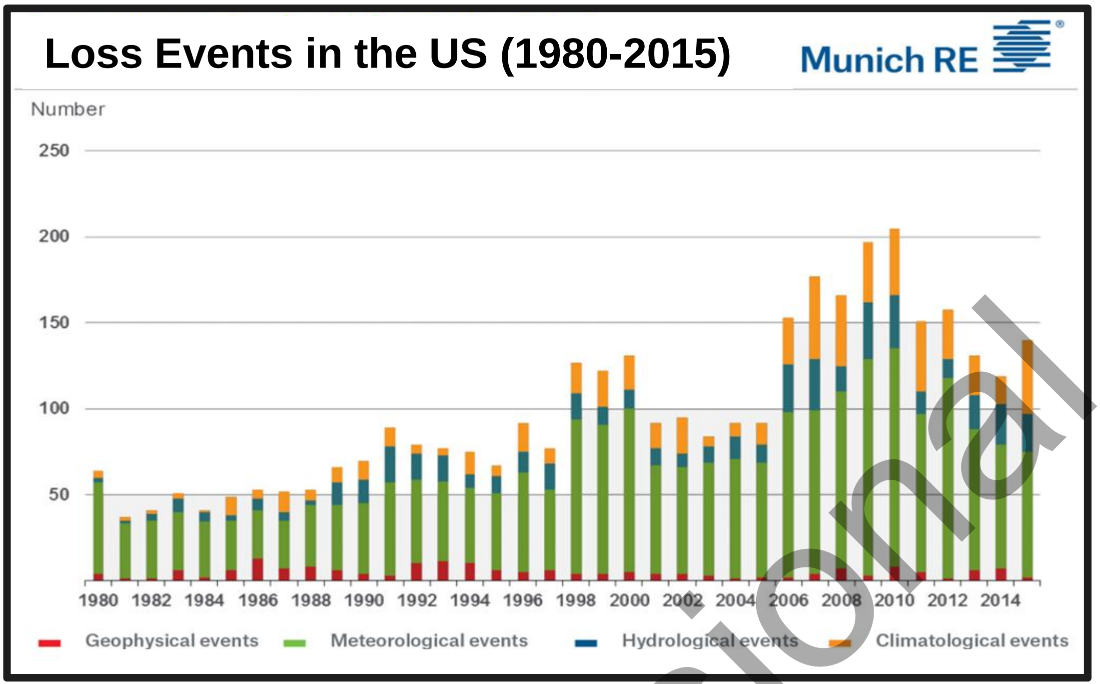
Despite high levels of satisfaction, not all partners receive the level of service they expect or that NWS believes they need. Interviews with partners and field leadership highlight several cases:

- Managers and partners reported that they would value additional daytime hours from local WFO staff to assist in interpreting forecasts and preparing for events
- Several field leaders and partners have reported needs for dedicated liaisons (e.g., FEMA, CDC) or for event-driven embedding of NWS staff (e.g., state EOC) – "our operations were delayed every day because we could not understand the forecast, and we did not have anyone by our side to help us"
- Managers report that their office is not able to serve certain key decision-makers in their area of responsibility due to staffing constraints (e.g. Port Authority of NY and NJ, state government)
- Managers and staff report that they are not consistently able to schedule meetings with partners due to shift rotation
- Partners have also reported frustration with the varying consistency of NWS products and levels of service between WFOs within a state. One state-level EM confided that they had learned to simply avoid interacting with certain WFOs altogether due to poor service.
- Partners report that their local field office does not have time to prepare products they need for decision-making: "…forecast information [from NWS] is distilled into high-level briefing documents and distributed to our partner organizations…similar products could be created by NWS personnel which would save time and, more importantly, limit potential interpretation inaccuracies"

Additionally, demand for NWS services may increase over time, as weather trends suggest increased volatility and vulnerability of the population (Exhibit 11).[10]

10 Munich RE; Environment America

Exhibit 11: Loss events in the US are increasing



Though generally high customer satisfaction was observed in the diagnostic surveys and interviews, areas for improvement were noted. Specific areas for improvement for NWS included realigning its product set, tailoring communication, increasing capacity, and improving precision. Some external stakeholders, particularly in the private sector, also noted confusion about IDSS and the bounds of the service provided.

Exhibit 12: "What was heard"

Key themes	What was heard	
Realigning products	"Too many products means that people need to go to multiple places for relevant products--needs a reorg around key customers"	"Need more help with damage assessments after the events—we cannot always count on this at all or in a timely way"
	"Timing of products to link up with customer needs (particularly broadcast media); otherwise they lose dissemination value"	"NWS should really push for an end to end view multi-party view especially on water -- can we share more data?
	"Apps, social media and texts need to be built quickly--websites are becoming obsolete"	
Tailoring communi-cation	"Communication within products needs to be concise and consistent"	"The feedback loop could be better—there is not as much after action sharing about learning"
Increased capacity	"More capacity overall but especially with our end users (business other government agencies and consumers) for IDSS -- "we need more on-site capacity pre and during events"	"We need someone on-site. [In a recent event] our operations were delayed every day because we couldn't understand the forecast"
Improving precision	"EAS notices are not targeted enough for locations because they're based on census areas"	"We would love to see more finer lines of accuracy—and greater degrees or at least transparency on the degree of certainty and confidence in the forecasts"
	"We could use more training—for example with storm spotting"	

SOURCE: Site interviews

The diagnostic found that across the NWS, there are differences in the interpretation of IDSS along four key dimensions: “what” IDSS means, “how” IDSS is delivered, “to whom” IDSS is delivered, and “when” IDSS is delivered (Appendix, IDSS Findings). These differences in interpretation lead to variations in how offices are performing IDSS.

IDSS activities are performed according to three different archetypes. First, Type 1 offices concentrate IDSS activities among certain people in the office. Examples include offices where managers and senior forecasters are responsible for external relationships. Others decide that certain employees should not engage in IDSS—either because of skill set or by personal choice. Type 2 offices establish a dedicated IDSS shift that staffed throughout each day or combine IDSS duties behind the Public Desk. These offices staff most forecasters on these desks, but the specific responsibilities rotate among the employees from day to day. Finally, Type 3 offices adopt the “whole office” concept where it is the responsibility of all employees at all times to engage in IDSS on an as-needed basis. In these cases, IDSS is understood to be a part of the responsibility of every shift or desk in the rotation (Exhibit 13).

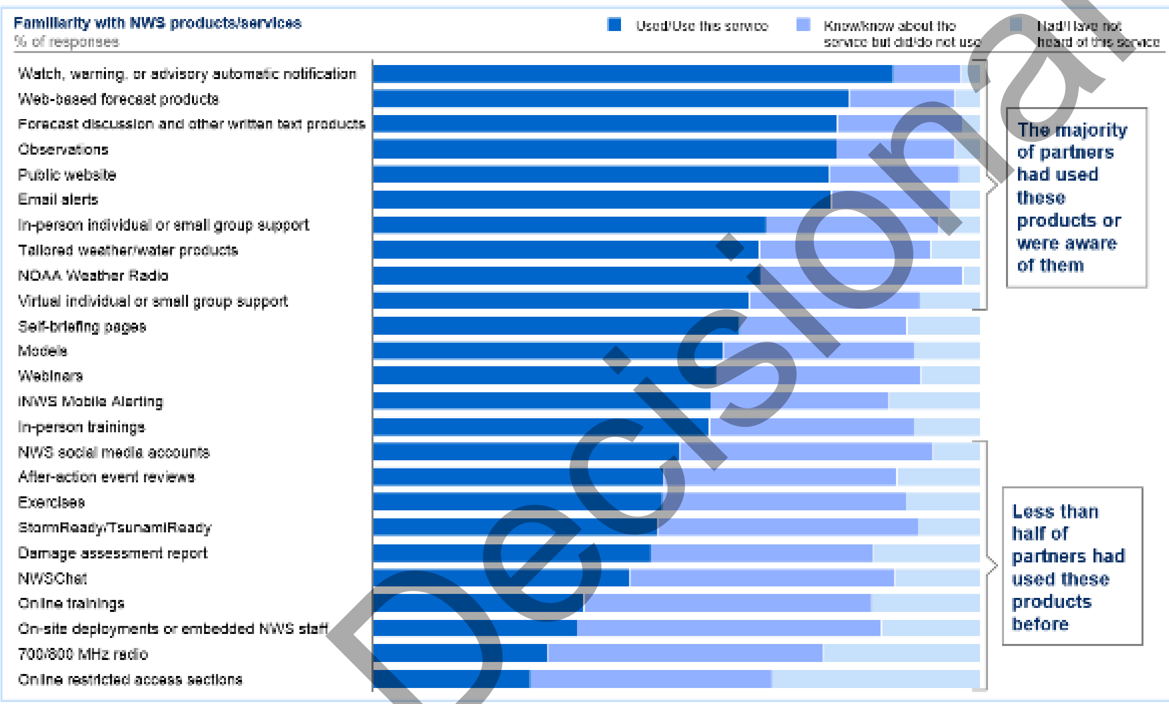
Exhibit 13: IDSS operating model varies across WFOs

SOURCE: Site interviews

Partner product knowledge is variable

Along with inconsistencies regarding the delivery of IDSS to partners, there are also inconsistencies around the delivery of products to NWS partners. In the CX Survey, partners were asked to rate NWS products and services along 3 dimensions: 1) had they used the products before, 2) were they aware of the products but had not used them before, or 3) were they unaware of the products. The responses showed that partners had variable awareness of the NWS product suite and used products in varying amounts (Exhibit 14). Towards the top of the Exhibit below, the majority of partners had used and were aware of products such as watch, warning or advisory notifications; web-based forecast products; forecast discussion and other written text products, observations, the public website, etc. However, towards the bottom, less than half of partners had used products like the online restricted access sections, 700/800 MHz radio, on-site deployments or embedded NWS staff, online trainings, NWS chat, etc. While not all products are relevant to all partners, this research begs the question – are the most valuable NWS products being used by our partners? Should the NWS invest more in heavily used products and/or divest in certain less-utilized products?

Exhibit 14: Partner familiarity and use of NWS products varied widely



This data also suggest that the NWS could consider more actively marketing its services to partners. In the CX survey, several partners even unsolicitedly mentioned in the free-text comments that they would like the NWS to be more proactive about educating them on products:

- "Continue reaching out to organizations and let them know what new NWS products and services are available."
- "When new products come out, share them and teach us how to use them."

IDSS matters to NWS partners, who say IDSS helps improve their decision-making

In the diagnostic, partners said that Impact-Based Decision Support Services help improve their decision making, including quotes like, "During a severe weather event, NWS helps us ensure there's not going to be a large loss of life." Trust and relationship building were often cited as primary reasons for satisfaction with NWS, including, "I trust my partners at NWS and I know them – the tone of their voice, the way they report out to us. And they know me." NWS IDSS was cited as being timely, relevant, and accurate, and highly valued for decision making. Partners also commented that they valued NWS's role as a translator of scientific information into actionable insights.

However, the NWS may be over-serving certain partners

Despite high levels of quality service experienced, partners indicated that higher service did not always correlate with improved decision-making. In the CX Survey, partners rated the NWS highly across quality service dimensions (Exhibit 15), which were defined as the following:

Components related to NWS staff:

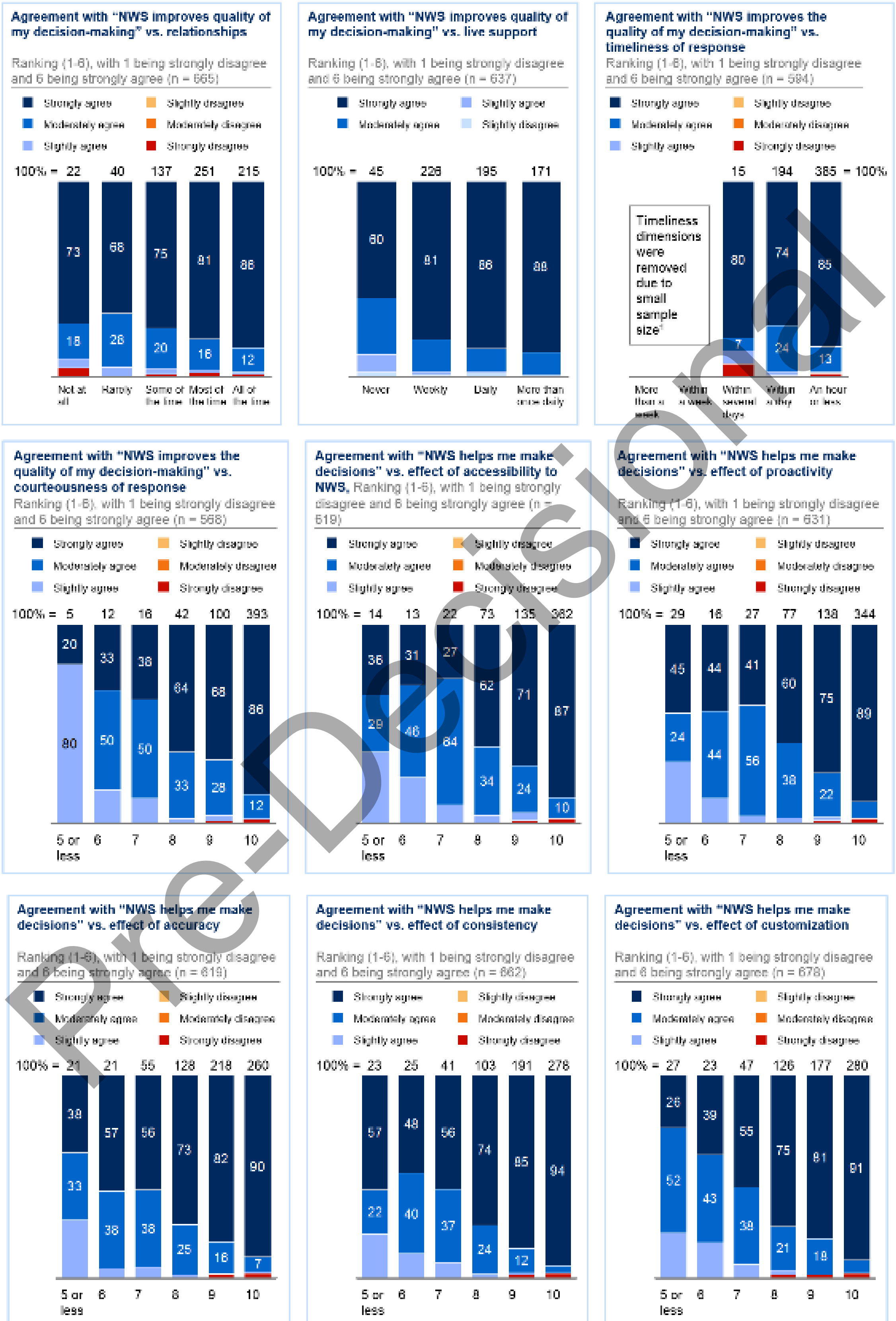
- Strong relationships with the NWS
- Live support from the NWS
- Timeliness of response
- A courteous staff member
- Accessibility of staff
- Proactive nature of NWS staff

Components related to NWS products:

- Accuracy of forecasts
- Consistency of forecasts and messaging
- Level of customization

However, even at lower levels of quality service, partners reported similar levels of decision-making, suggesting that the lengths that NWS staff go to serve partners well (e.g., serving them quickly, with frequent live support) may not be necessary to help them achieve their missions. For example, in the first chart below related to relationships, partners that did not have strong relationships with the NWS still reported being able to make decisions at almost the same level as those who did have strong relationships in the NWS. Similarly, looking at the last chart, partners who received information in less than an hour were able to make decisions at almost the same rate as those who received information within several days. This suggests that the NWS may be over-delivering in some cases and could vary service levels by partner needs.

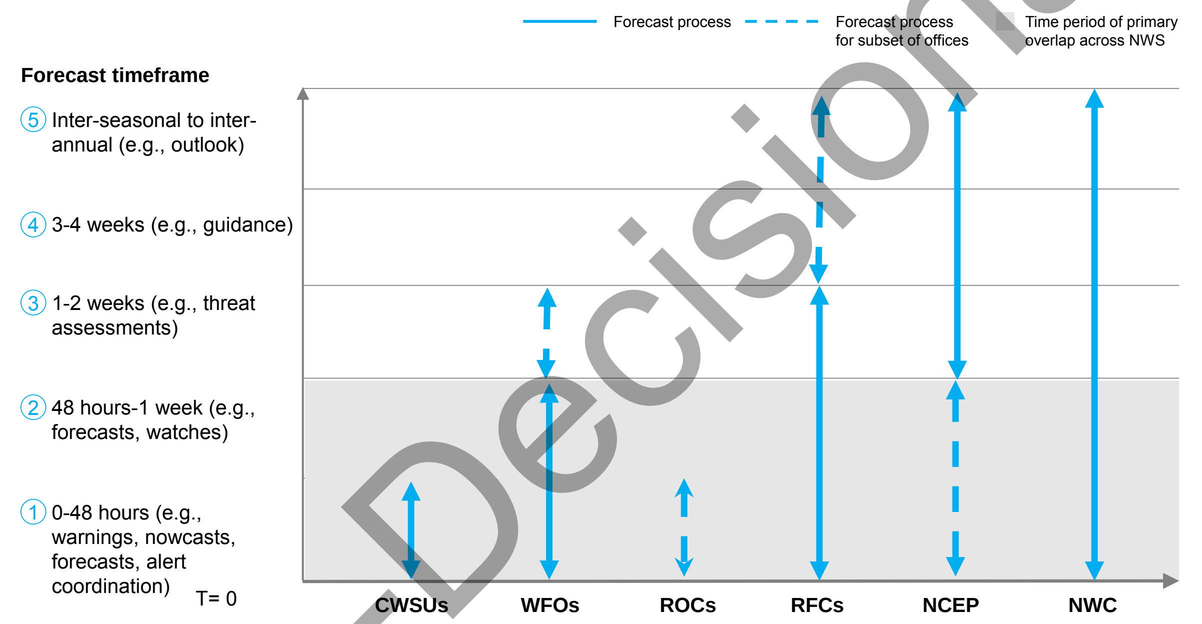
Exhibit 15: Across some dimensions of quality service, partners report that the NWS helps them make decisions at a relatively constant rate



Finally, the forecast process has some duplication of effort, does not make best use of local staff time, and can result in inconsistent forecasts

The current forecast process at NWS involves all field offices and results in some degree of duplication across those offices. The primary area of duplication is in creating forecasts for the near-term (0-48 hour time range), though WFOs and NCEP overlap meaningfully in the medium to long-range as well (48 hours – 1 week)[11]. While there is some rationale for field offices to add expertise to the forecast, roles are not clear. As such, NCEP invests time and effort in creating forecasts, often referred to as guidance, distinct from WFO forecasts. The WFO forecasts are used to create most of the National Digital Forecast Database (NDFD), which is available to the public and used for IDSS. NCEP forecasts, often in graphical (not GIS) form, are also available to the public and used by some partners for IDSS.

Exhibit 16: Duplication of effort in forecast process



The current NDFD forecast process is decentralized and largely governed by local office policies. NWS stitches together individual, independent forecasts created at its 122 WFOs to create a national forecast. Many meteorologists at NWS manually select model guidance to incorporate into forecasts on each shift, for the majority of elements, despite the evidence that ensemble blends are on average sufficient for many elements[12]. Each office may develop its own unique tools for its meteorologists to use to populate the gridded forecast (i.e., the GIS-based forecast for the country) from the multitude of models available, to create additional forecast fields (e.g., weather type, snow), and to adjust individual elements (e.g., temperature, precipitation).

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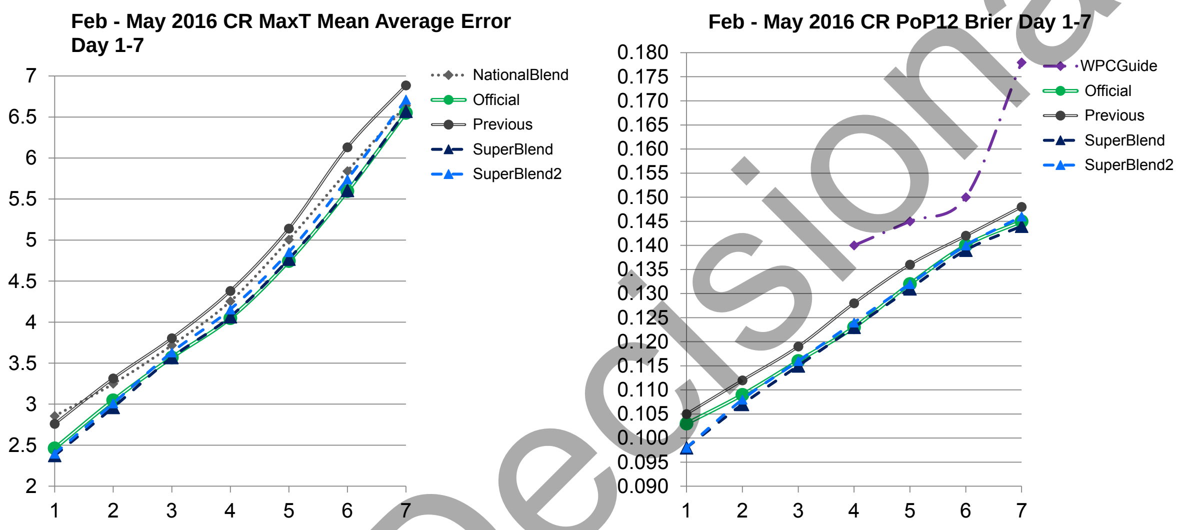
11 Interviews with NWS managers, site visits, review of products and services

12 Interviews with NWS managers, site visits; SuperBlend verification; Initial NBM verification

Some NWS Regions have adopted regional policies that require the use of a common, blended starting point for the forecast and collaboration across WFOs if changes are made. In Central Region, analysis has shown that the regional blend (SuperBlend), with and without the European model included (SuperBlend2 excludes), is on par with or superior to the official WFO-generated grids[13]. The analysis included in Exhibit 17 is not intended to be generalized to all elements or events, but suggests model blends can provide a starting point for forecasting. Initial analysis of the National Blend of Models shows that it will likely be similarly skilled, although currently the NBM version 2.0 does not contain the full set of elements needed (NBM version 3.0 is scoped for all elements)[14]. Blended model output for some elements, though, (e.g., wind) is not as skillful.

Exhibit 17: Comparison of forecast techniques (Max temperature, Probability of precipitation)



As WFO meteorologists adjust model output, they may use guidance from NCEP (e.g., if a hurricane is forecast, WFO meteorologists will add in appropriate winds, precipitation, waves etc.). This process is highly manual and varies from person to person. NCEP has access to datasets and models that WFOs do not have access to, for bandwidth reasons, which can make it very difficult for WFO meteorologists to incorporate NCEP guidance.

The outcome of the process today is a forecast that may be inconsistent in several ways: 1) the forecast may contain meteorological inconsistencies (first order discontinuities), as forecasters independently edit elements that are related, 2) the forecast may contain inconsistencies from shift to shift, as local forecasters have different areas of interest and skill levels, 3) the forecast may contain inconsistencies across office boundaries if changes are not collaborated, 4) the forecast may be inconsistent with the message delivered nationally, given NCEP does not use the same tools, and is not generally part of the gridded forecast process. The result is that

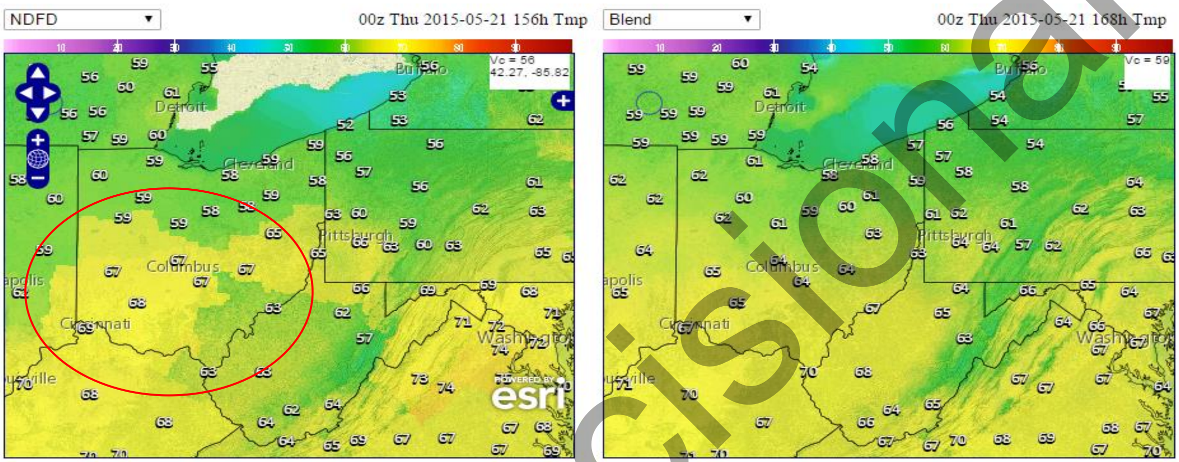
13 Central Region Scientific Services Division

14 National Blend of Models Development team, May 2016

partners see and hear different forecasts and messages, making decision-making more difficult or eroding trust in NWS.

While some regions have adopted consistency measures that seek to remove “seams” at borders of WFO areas of responsibility, inconsistencies in the forecast persist. Regional Operations Centers (ROCs) are also involved in reducing inconsistencies in both the forecast and threat messaging between NCEP and local staff, which requires time-consuming collaboration and negotiation across offices. Compounding the inefficiency is the fact that WFOs and NCEP do not currently use the same IT to produce their forecasts.

Exhibit 18: Comparison of "seams" in NDFD to smooth forecast using a blend



This process does not make the best use of NWS staff time, either at the national level or at the local level. The expertise at NCEP may not be used in the local forecast process, the latest technology (e.g., model blends) is not fully utilized, and local expertise must be added at each forecast cycle rather than being added automatically through post-processing.

FINDINGS ON NWS’S ORGANIZATIONAL STRUCTURE

Summary: The current field structure, particularly how staff and resources are allocated geographically, does not best support the IDSS operating model. The roles and responsibilities of field offices require additional clarity, particularly where there is overlap. Within WFOs, staff time may not be spent on the highest value activities due to the current responsibilities assigned to meteorologists. Additionally, while the local reach of NWS field offices supports the IDSS operating model, there are some functions that could be more effectively and efficiently delivered across multiple WFOs (e.g., gridded forecast production, “met watch” in some cases, warnings in some cases – all to be tested before further consideration or implementation). Finally, within and among offices, the span of control for field managers is too high to manage in the new service delivery model.

NWS has three levels of offices in its field structure: national (NCEP), regional (RFCs, ROCs, Tsunami Warning Centers), and local (WFOs, CWSUs). Alaska and

Hawaii have additional regional offices, the Alaska Weather Water Ice Center (AWWIC), the Alaska Aviation Weather Unit (AAWU), and the Central Pacific Hurricane Center (CPHC). The field footprint is dispersed, with WFO locations based on radar positioning, RFCs based on river basins, CWSUs located near major airports, and NCEP and the National Water Center located based on weather events and other factors. The NWS also organizes its activity around 11 service programs (e.g., marine, tropical, tsunami, fire).

Overall, there is not sufficient role clarity or optimal balance of functions across these field offices. The diagnostic found: 1) a lack of role clarity between the newly reorganized National Service Programs (NSPs) and the National Centers for Environmental Prediction (NCEP), as well as inconsistencies in NCEP roles and responsibilities 2) a lack of alignment between the various tsunami offices, 3) a lack of coordination between River Forecast Centers (RFCs) and the newly created National Water Center, and 4) staff in WFOs do not have sufficient time or flexibility to deliver IDSS, and that some WFO functions could be more efficiently or effectively delivered across multiple offices.

Lack of role clarity between the newly reorganized National Service Programs (NSPs) and the National Centers for Environmental Prediction (NCEP), as well as inconsistencies in NCEP roles and responsibilities

The National Centers for Environmental Prediction (NCEP) are comprised of seven "service" Centers (AWC, CPC, NHC, OPC, SPC, SWPC, WPC) and two additional Centers (EMC, NCO) that provide foundational modeling and processing capabilities. Among the service Centers, there are inconsistencies in roles and responsibilities; one Center provides warnings, watches, and advisories, while the rest provide either watches and/or outlooks.

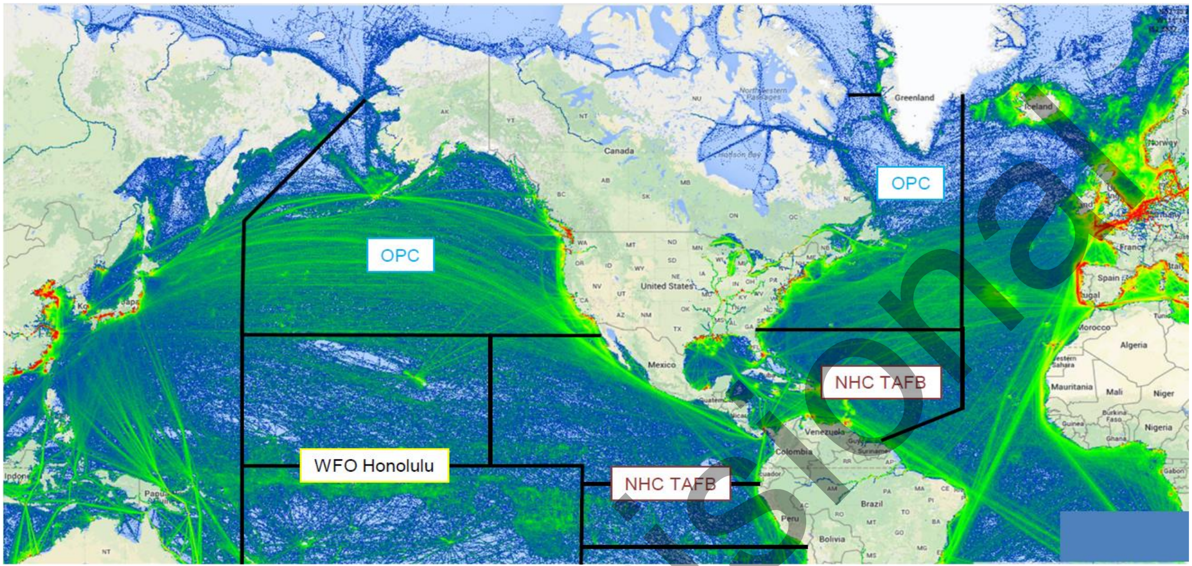
Exhibit 19: Roles of NCEP Centers vary by service area

Organizational authority for issuing standard products by weather event

	Outlook	Watch	Warning
Severe thunderstorms / tornado	SPC	SPC	WFO
Winter storm	WPC	WFO	WFO
Hurricane / tropical storm	CPC: hurricane seasonal outlook	NHC: coastline	NHC
	NHC: Weekly	WFO: water going out 20 mi.; inland OPC: >60 miles	WFO
Flood	WPC: excessive rainfall	WFO/RFC	WFO/RFC

Many staff perceive the Centers to provide “guidance”, not forecasts, while Centers do issue products that contain forecast information directly to the public and to partners. Some Centers, such as OPC, produce forecasts, which can create additional complexities – the boundaries of OPC, NHC TAF-B, and WFO forecasts, for instance, do not match partner needs and require increased coordination.

Exhibit 20: Division of high seas forecast responsibility vs. shipping lanes



Additionally, several Centers play a role in forecasting water – WPC, OPC, NHC, OWP/NWC – creating a fragmented national water picture and lack of role clarity for some functions (e.g., predicting storm surge). Similarly, several centers – AWC, SPC, WPC – regularly need thunderstorm and precipitation forecasts, but each may consider the likelihood of such storms separately.

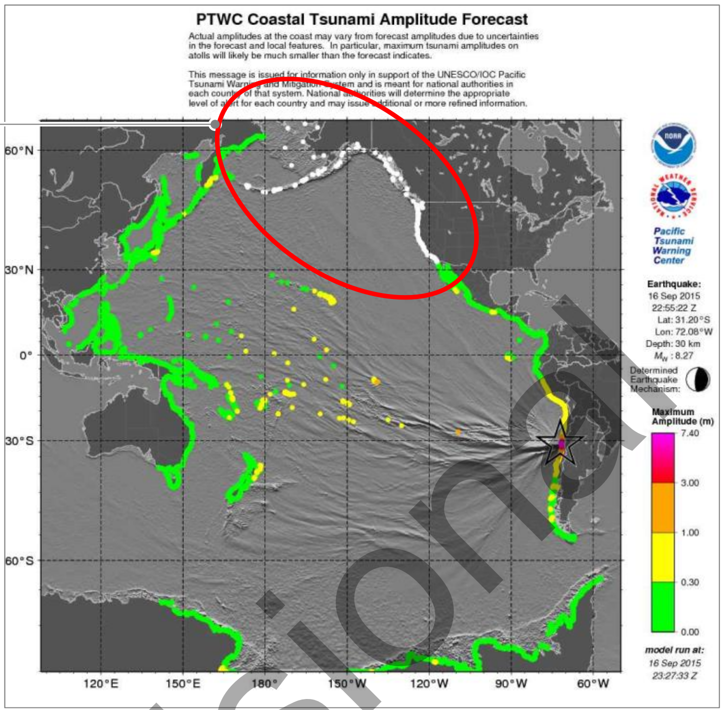
Finally, there is a lack of role clarity between the National Service Programs (NSPs) and the Centers. The 11 NSPs aim to provide ownership of each type of weather and water concern handled by the NWS, yet the Centers are not divided cleanly according to NSPs (e.g., WPC handles winter weather, public weather, and some water, while OWP/NWC handles water as well). The role of the NSPs and the Centers in programming and budgeting decisions has not been clearly defined.

Tsunami Warning Centers are not aligned to partner needs

NWS has two Tsunami Warning Centers which operate largely independently of each other yet have areas of responsibility that border each other. Currently, the two TWCs issue forecasts for their respective areas of responsibility, meaning a single seismic event leads to two forecasts, which may not be consistent with one another. Each Tsunami Warning Center is fully staffed for 24/7/365 watch functions, and each Center also has research and development functions.

Exhibit 21: Tsunami Center roles not aligned to partner needs

PTWC whites-out the West Coast of the United States so that they will not conflict with forecasts from the NTWC, which is troublesome for core partners with trans-Pacific interests



There is a lack of role clarity between River Forecast Centers (RFCs) and the Water Prediction Center/National Water Center (OWP/NWC)

The 13 River Forecast Centers (RFCs), organized by river basin, have well defined roles and responsibilities when it comes to providing forecasts and serving partners. Generally, these partners are defined by river basins (e.g., dam operators) and are more regional in nature than WFO partners (e.g., Army Core of Engineers), resulting in less overlap across offices. Each RFC also calibrates and operates a distinct version of a common river forecast model; the diagnostic did not find evidence that RFCs significantly overlap with each other in forecast areas. RFCs do overlap in forecast responsibilities with WFOs in the production of the precipitation forecast. RFCs publish a separate Quantitative Precipitation Forecast (QPF) as used in their river models; the forecast is not meant to conflict with WFO or WPC QPF (which also exist independently), but it is available to partners and could be seen as such. Additionally, RFCs devote 2-3 staff resources (HMTs: Hydro-Meteorological Technicians) to developing a QPF forecast[15]. RFCs have varying policies on how to create the QPF, with some RFCs using WPC inputs, others using WFO inputs, and still others producing QPF for nearby WFOs. Testing has not been done to determine if WPC and/or WFOs could produce QPF sufficient for use in the river forecast models such that those resources could be deployed elsewhere.

The RFCs are asymmetrically staffed, largely according to the frequency of 24/7 operational needs in response to emergency events. Some RFCs reported significant

15 Table of Organization, June 2016

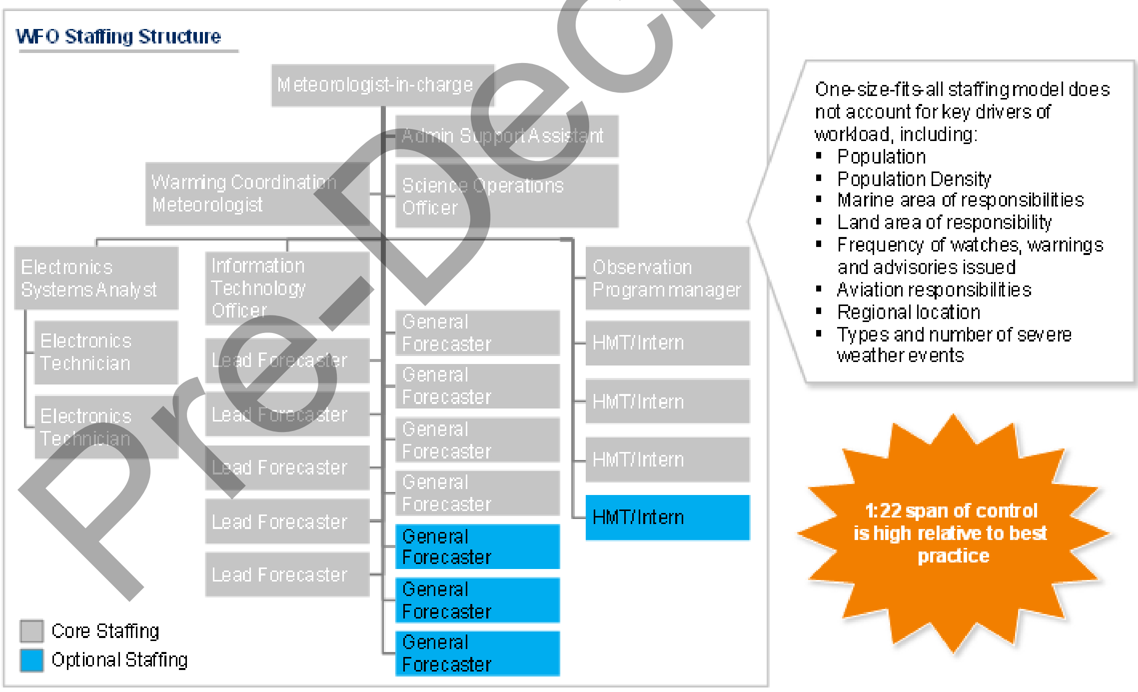
overtime hours and operational risk of not being able to sustain 24/7 operations as needed particularly for long-lasting flood events.

Finally, at the time of the diagnostic, the roles and responsibilities of the RFCs in light of the new national water capabilities envisioned for the Office of Water Prediction's National Water Center (NWC) had not yet been determined. There is the potential for significant overlap of function and inconsistency if the roles and responsibilities of each type of office are not clearly defined. The OWP/NWC may present an opportunity for RFCs to shift time from forecast production and model calibration to delivery of services to partners.

Staff in WFOs do not have sufficient time or flexibility to deliver IDSS due to cookie-cutter staffing, current responsibilities, 24/7 requirement, and requirement of 2 people per shift

WFOs currently have a "cookie-cutter" staffing and operational model designed during the Modernization and Associated Restructuring (MAR) from the 1990s. Each WFO is located near a radar site and is comprised of ~12 forecasters, management staff (MIC, SOO, WCM), and support staff (electronics maintenance, IT, observation program, and administrative). Each WFO operates 24/7/365 regardless of weather or partner needs, with a minimum of two people staffed at a given time.

Exhibit 22: "Cooke-cutter" staffing model at WFOs



The NAPA report found that, "...the current structural model...does not optimize decision support services; the NWS needs more public outreach into the major metropolitan areas. The act of co-locating offices near the base of radars due to data transmission limits had the unintended effect of moving some offices and the workforce away from population centers and actually diminished in-person communication with decision makers…Today's technology could free NWS personnel from the base of the radars and allow them to become more agile and effective. Becoming more mobile and adaptable will likely also provide opportunities to ease budget pressures.[16]"

The OWA diagnostic reiterated this finding and its impact on the capacity of the NWS to deliver IDSS to critical partners. Regional Directors cite multiple instances of offices being positioned far from core partners, particularly on the East and West Coasts (e.g., Upton, Oxnard), and in Central and Southern regions as well, where some offices are not positioned in the state capitol or otherwise most populated metropolitan area. Additionally, partners such as FEMA Regions and state governments must work with multiple WFOs for a given event, and may not have a dedicated liaison (although some WFOs have designated a primary office). Although there are many drivers of workload in addition to population, it serves as a proxy in many cases for where decision-makers are likely to be located.

Center Weather Service Units (CWSUs) also have a cookie cutter staffing model. CWSUs are largely aligned to FAA partner needs, per the interagency agreement, and they are each staffed with four employees regardless of size and scope of the partner needs they support. Staff report the need for additional staff focused on the aviation mission at select CWSUs, those making up the Golden Triangle Initiative (Chicago, New York, Atlanta), and potentially others (e.g., Washington DC). WFOs also contribute to the aviation mission by providing Terminal Aerodrome Forecasts (TAFs) and IDSS for local air strips not governed by the interagency agreement. WFOs also produce the pacing TAFs (OEPs) for major airports. There may be an opportunity to better align forecast roles with IDSS roles by shifting some TAF responsibility to CWSUs.

WFO functions

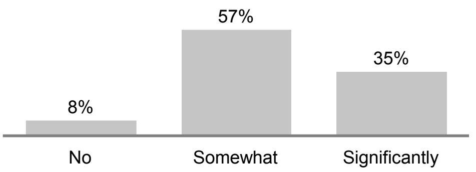
A survey of MICs, with 100 of 122 MICs reporting, found that >90% of MICs find the current shift schedule and staffing constraints restrict their ability to enhance IDSS.

16 National Association of Public Administration, Forecast for the Future: Assuring the Capacity of the National Weather Service, 2013

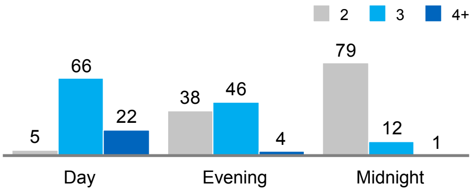
Exhibit 23: MICs report shift requirements constrain IDSS

92% of MICs reported that shift requirements constrain enhancing IDSS

MICs constrained by shift requirements
% of MICs, n = 97



Forecast desks staffed per shift
# of WFOs staffing 2, 3, or 4+ desks



1 17% of MICs listed vacancies as a constraint

MICs report that requirements for operating hours and staffing levels constrain ability to meet day-time hour partner needs[1]

> To really effectively allocate staff resources, **I need to be able to count on having specific staff members/or focal points available** in the day time, when core partners can meet

> **Hard to plan "green" days in advance with rotating shifts**, people coming and going etc…We can't just drop in on them with little notice…need to be able to plan what to do on down days.

> We do NOT need 2 people on midnight shifts. **Surge when needed**; work Mon-Fri DAYS and EVES most of the time. **Overnight only as needed**, and at the production centers. SPC should do all the convective products (including warnings) and WPC all the Winter, QPF, etc. Fire weather should be done nationally in Boise.

> Shift work is not healthy…**improving health improves our ability to be flexible and adaptable** to our operational needs.

> [We're **constrained by] fixed operational shift hours** 24 hours/day

> I really don't need 2 people on the midnight shift or 3 on the evening shift. Those **duties could be better accommodated with more time for IDSS during the day** and less emphasis on grid production.

> Interns are working mainly evening & midnight shifts, with **little time for training & performing IDSS**

The 24/7/365 staffing model, at two people required per shift, also introduces risk and rigidity into the WFO staffing model. In order to staff 42 shifts a week, as required at minimum, each WFO needs 11 meteorologists (assuming each meteorologist can cover 4.2 shifts per week, an assumption used by Southern region in workforce planning, given paid leave, sick leave, training, etc.)[17] – if there is even one vacancy or one instance of leave, the office must rely on its management team to operate shifts, and yet managers are meant to interface directly with the most critical partners, manage the performance of the staff, and oversee operations. Managers (Meteorologists-in-charge, MICs, Warning Coordination Meteorologists, WCMs, and Science & Operations Officers, SOOs) are even staffed on midnight shifts, outside of core operational and management hours, to make up for shortages at WFOs, severely restricting their ability to train staff and manage operations.

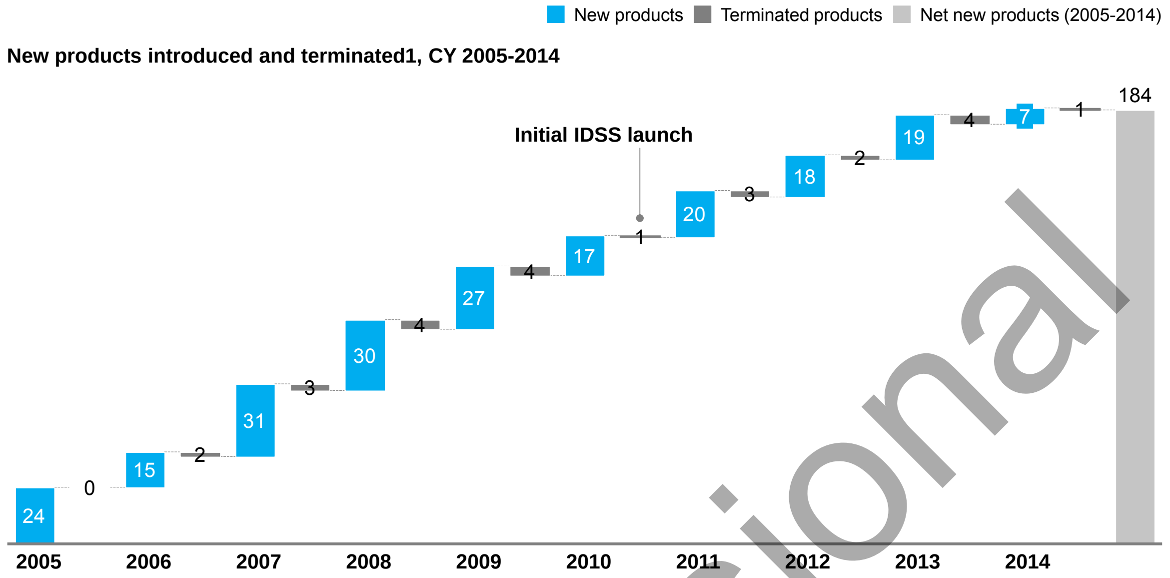
Staff at many WFOs report that there is not an equal amount of work on all shifts – the MIC survey results show that while there is variation in staffing levels in the day shift, virtually all offices staff at the minimum two meteorologists overnight, and in many cases staff report there is not sufficient work to occupy two people at this time. Even given critical "met watch" duties (monitoring for threats in the near-term), two people are not needed on shift at every WFO. With proper on-call systems in place, NWS could operate fewer met watch shifts to cover the nation. In some cases, this may be true of the evening shift as well. The rotating shift model also restricts training activities in the office, as management may go two weeks without being in the office at the same time as a rotating shift worker.

The roles and responsibilities currently assigned to WFOs limit the amount of time and flexibility available for IDSS. WFO staff are currently required to produce the gridded forecast and myriad forecast products – the number of forecast products

17 See Hiring Freeze Arbitration, Sharnoff decision, pages 79-80.

continues to increase with little retirement of older products – and to do tasks such as answering inquiries from the general public and launching weather balloons.

Exhibit 24: Forecast products over time



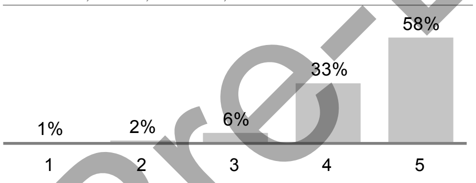
1 Includes all products reported to Headquarters for approval during the 2005-2014

Over 90% of MICs report interest in reducing the amount of time their staff spends on gridded forecast production, and 25% explicitly mention grid production as a top constraint in effectively allocating staff in their WFO (for comparison, 17% of MICs cited vacancies as a top issue).

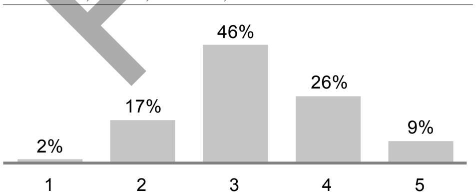
Exhibit 25: MICs report grid production not highest value activity

>90% of MICs are interested in shifting time from grid production to IDSS, but believe staff are "on the fence"

Manager interest in spending less time on the gridded forecast
% of MICs, n = 97, 1 = least, 5 = most



Perceived forecaster interest in spending less time on the gridded forecast
% of MICs, n = 97, 1 = least, 5 = most



~25% of MICs reported that forecast production duties, including grid editing, limit their ability to effectively allocate staff in their WFO

" Using the Super Blend for days 4-7 saves us 90 to 120 minutes in grid forecast preparation on the day and mid shifts - **we reinvested the time saved into customized IDSS for partners**

" The use of blended models and good tools to make modifications when **needed could allow us to have one person handling grids and others doing IDSS**

" We **need to come out with a policy to not edit grids but once a day** beyond day 3, maybe even 18-36 hours and stop a lot of the nonsense tweaking of the grids

" There remains **a lot of legacy work realized via grid production**

" We need **production of everything to be done centrally**, and the offices (should not call them WFO's anymore, either) that provide service should be staffed like RFC/CWSU/etc

" Although we're trying to shift to the forecaster over the loop approach, some of our **forecasters still have to waste time because adjacent offices tinker with meaningless changes** in portions of the forecast, especially the longer term periods

" [We're constrained by] routine grid duties even when weather is benign

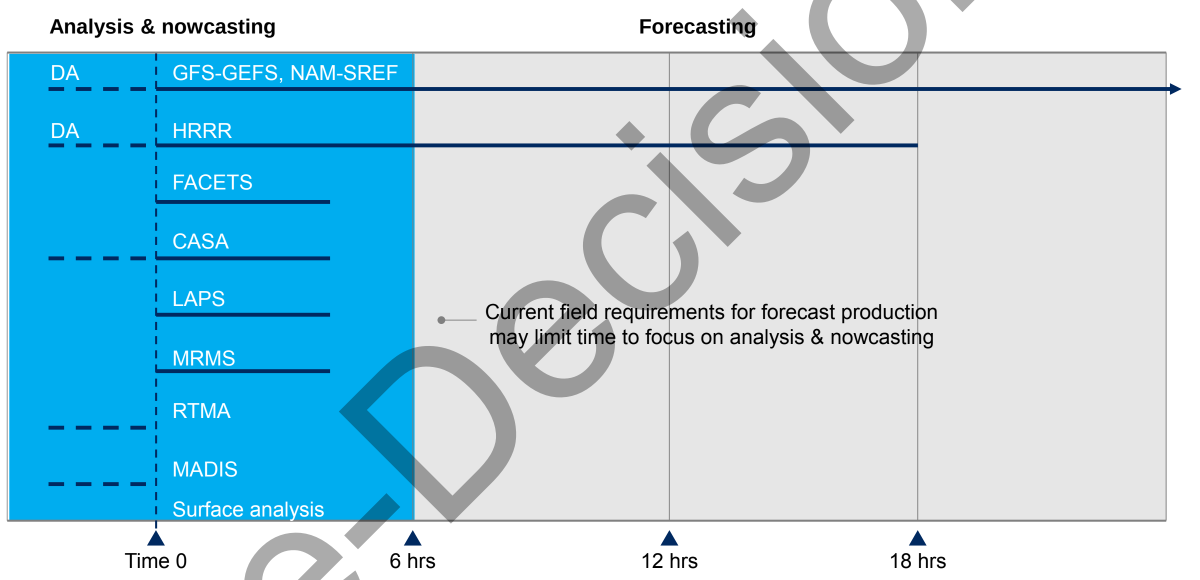
At many offices, junior meteorologists (GS levels 5, 7, 9, 11) are not given tasks directly related to forecast production or IDSS; rather, they operate the Public Service Unit, which performs more general outreach and administrative duties. Over time, the workload associated with these functions has decreased, and nearly half of

GS-11s have not advanced to GS-12, leaving a potentially more productive talent pool untapped at many WFOs.

Based on site visits and the MIC survey, the diagnostic estimates that ~70% of WFO meteorologist staff time is spent on tasks other than IDSS, including general grid production, the Public Service Unit, and weather balloon launches, which are lower value add than the core science-based service functions critical to NWS's mission. See Appendix for detailed analysis.

WFOs play a critical role in met watch (maintaining situational awareness and delivering up-to-the-minute environmental intelligence on evolving situations), which includes warning production. Given increasing IDSS demands and the role of WFOs in the forecast process, WFOs are not able to continually staff around-the-clock dedicated met watch. In fair-weather, the met watch function is shared among staff who are also forecasting, interfacing with partners, and preparing for upcoming events and outreach.

Exhibit 26: Focus on forecasting may limit time for situational awareness



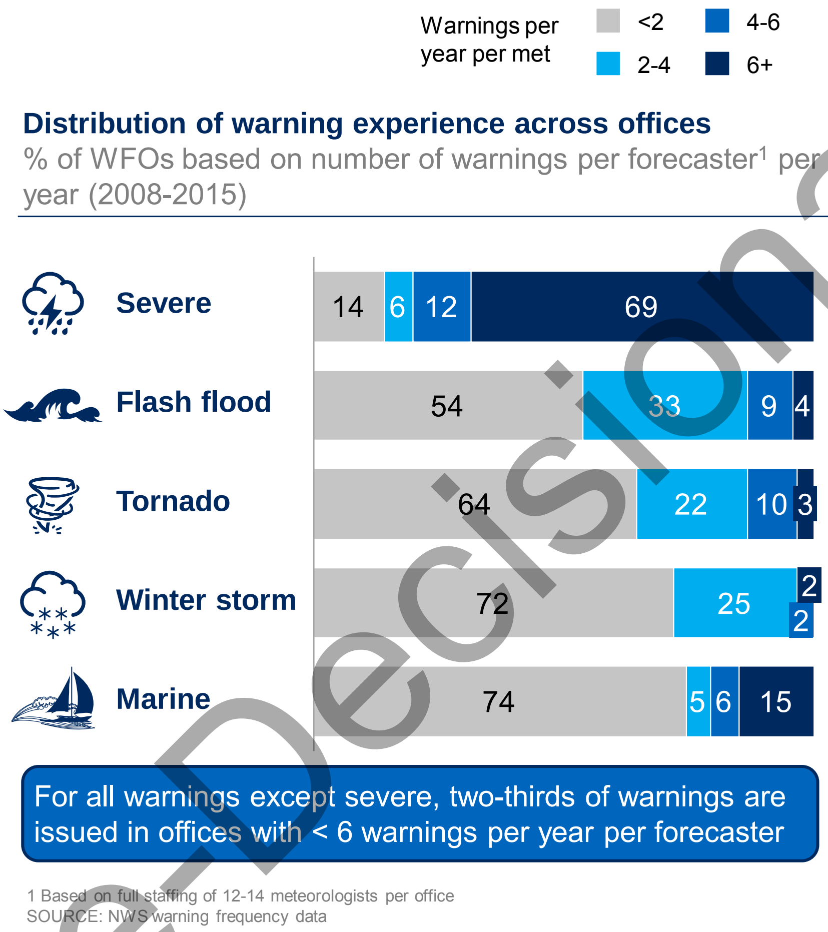
Some current WFO functions are not effectively delivered within an individual office

Warning production

Currently, each WFO produces warnings (i.e., warning issuance for a county warning area, with a call to action) used by the general public, media, and the emergency management community. Warnings are both a product (e.g., a polygon with a written call to action) and the basis for a service – the provision of hazard information and IDSS to partners. This finding focuses on the identification of the hazard and development of the product, not on messaging or IDSS related to warnings.

The current County Warning Area (CWA) assigned to each WFO presents a challenge in ensuring all meteorologists on duty have sufficient expertise and experience identifying hazards and issuing warnings. Warning frequency varies widely by office, and in the current operating model, meteorologists rotate through shifts that may include warning production. The rotational shift structure, paired with varying frequency of warnings across offices, means that individual meteorologists may not have sufficient experience in issuing certain warning types (Exhibit 27).

Exhibit 27: Meteorologist frequency of issuing different warning types



In interviews, office managers acknowledged that some of their staff are more skilled than others in these functions but that due to the rotational staffing model, it is difficult to guarantee an expert will be on shift when significant weather occurs. Analysis of tornado warning patterns in "tornado alley" suggest that there are 2-4 meteorologists who have issued the most warnings. Interviews suggest that offices develop "A" teams, or "go-to" forecasters who are preferred for warning operations. In the event of a significant outbreak, this "A- team" of 2-4 people is not sufficient to sustain operations over more than 24 hours. Furthermore, the field structure does not currently provide "hot backup" across offices – although there are service backup agreements in place in case an office goes down, there could be a gap in time when there is insufficient coverage.

Additionally, the current training model requires a uniform certification course, independent of where a meteorologist will be working and the associated climate. There are no formal advanced levels of training offered. Furthermore, warning performance data is not centrally managed at NWS, so assessing and improving performance is difficult.

Science and training functions

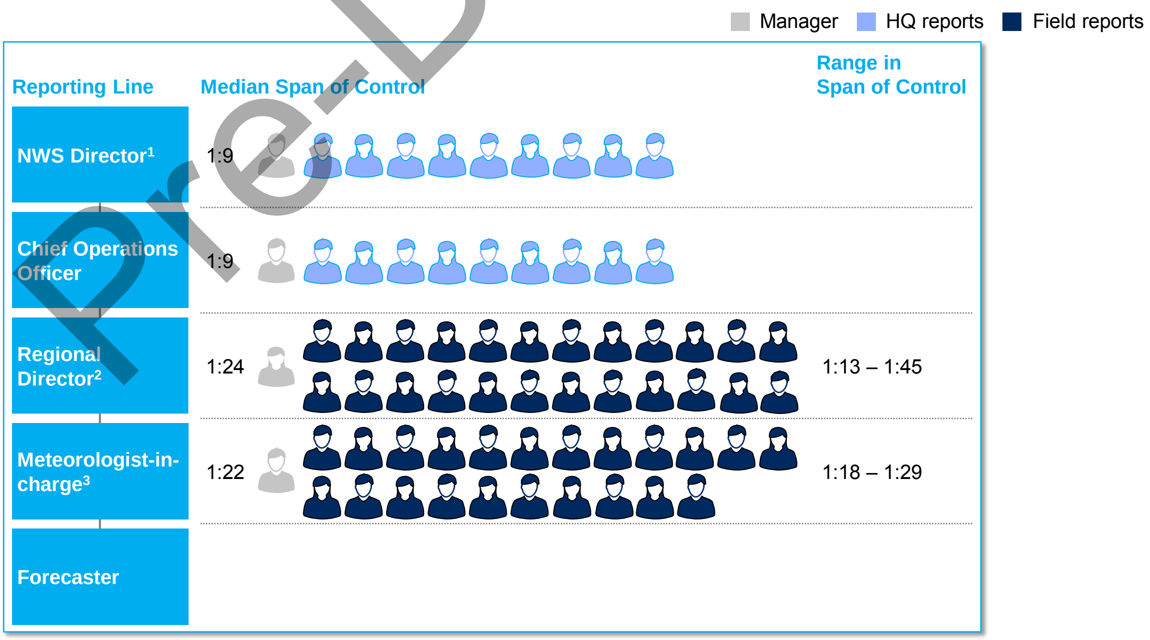
Currently, each office has a Science & Operations Officer (SOO) responsible for developing the skills of staff, with a particular emphasis on incorporating new science into operations and contributing to research efforts. The NAPA report found that, "absent a functional NWS process for R2O and O2R, many field operators who desire a new capability work on developing it themselves," which leads to inefficiencies and security risks. The current decentralization of research to operations efforts through the SOO program contributes to this difficulty.

Additionally, Field Directors and field managers report that individual SOOs vary widely in their ability to and interest in managing a training program. As with research to operations, there is minimal bridging between national training efforts and local field offices.

Span of control for field managers is high

The number of layers between the NWS Director and a frontline forecaster is relatively low (5 layers), but the spans of control (number of direct reports) within the field are high. For example, the number of employees reporting directly to a Regional Director ranged from 13 to 45 at the regional sites visited, and number of reports to MICs often exceed 18.

Exhibit 28: Number of direct reports at NWS by position



1. Shares some management responsibilities with Deputy Director and Chief of Staff.
2. Shares some management responsibilities with WCM and SOO.
2. Shares some management responsibilities with Deputy Director. Does not include direct reports at Regional HQ office.

Given the complexity of products and services provided by NWS staff, the high level of skill required, and the emerging nature of IDSS provision, current span in the field offices is not ideal. Best practice suggests that NWS's current span is appropriate for managers who play facilitator or coordinator roles, and staff who perform routine, identical tasks. The OWA site visits suggest that NWS needs to move towards coaching staff, which necessitates a lower span of control of 6-7 direct reports for each manager.

Exhibit 29: Best practices in span of control

Drivers of managerial work	Managerial role archetypes: Player / Coach	Coach	Supervisor	Facilitator	Coordinator[2]
Maturity of process	▪ No standard work process exists and tasks require conceptual problem solving with manager interaction	▪ Some work process guidelines have been developed but tasks often require manager intervention and interaction	▪ A standard work process exists and subordinates perform tasks that require limited interaction	▪ Work is performed on the basis of mostly standard processes OR sub-ordinates are largely self-managed with very limited manager interaction and intervention	▪ Work is completely standardized or automated, OR subordinates are self-managed. Interactive intervention is required only for exceptions
Time spent "managing" vs. "doing"	▪ Manager spends relevant time on own work or client-facing activities	▪ Manager may spend time on own work, often side-by-side to apprentice others	▪ Manager spends little time on own work or client-facing activities	▪ Manager spends most of the time "managing" OR work is mostly managed indirectly via metrics	▪ Manager spends nearly all the time "managing," OR nearly all work is managed indirectly via metrics, reviewing decisions, and handling exceptions
Task repeat-ability	▪ Every subordinate performs unique tasks that are different at every iteration	▪ Many subordinates perform varying tasks that, while repeated, often require some level of tailoring	▪ Most subordinates perform tasks that are similar and that repeat over time	▪ Most subordinates perform nearly identical tasks that are repeated at nearly every iteration	▪ All subordinates perform the same essential tasks independently OR are self-managed enough to handle non-standard tasks without intervention
Subordinate skills required	▪ Tasks require specific skills that take several years of experience and extensive apprenticeship	▪ Tasks require specific skills that take much experience and coaching. Skills acquisition can take up to a year	▪ Tasks require specific skills that take some experience, but limited apprentice-ship. Skill can take up to a month to build	▪ Tasks require general skills; job-specific knowledge can be learned very quickly, mainly via training and self-study. Skills can be taught within ~2 weeks	▪ Skills can be taught within a week because tasks require few specific skills and can be learned nearly entirely via self-study OR subordinates have total mastery of skills required before being in the job
Average span of control	3-5	6-7	8-10	11-15	>15

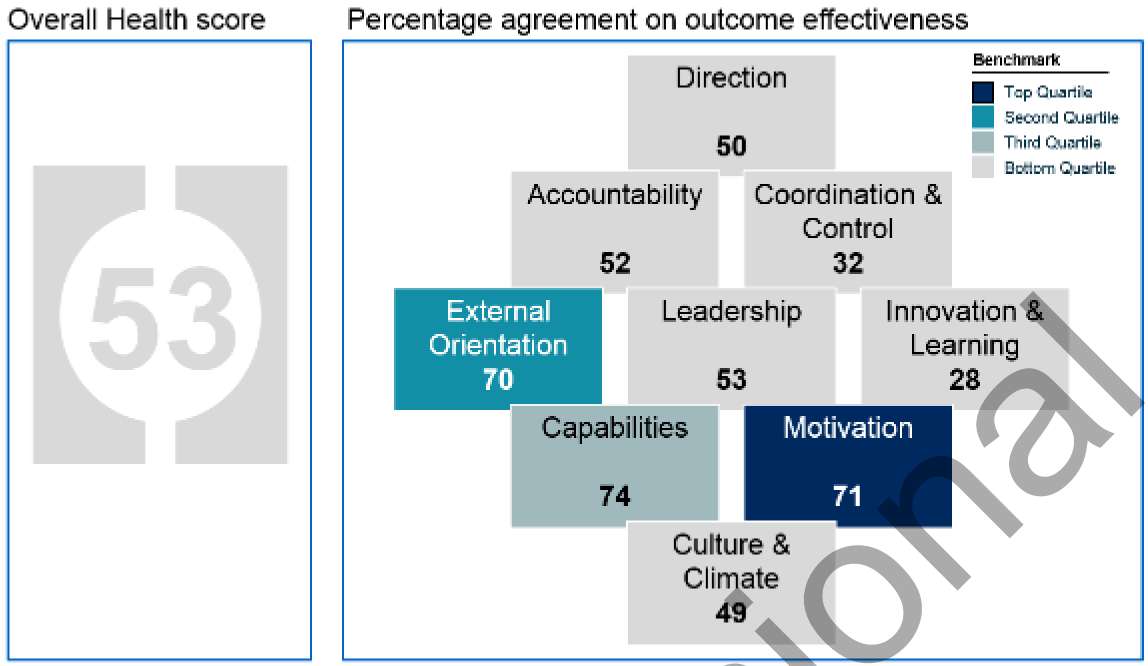
NWS's organizational health is not sufficient to support performance

The overall OHI health score was 53, a bottom quartile overall health score when compared to the global benchmark of roughly 1.3 million responses across approximately 700 public and private sector organizations worldwide.

At the outcome level, six of the nine outcome scores were in the bottom quartile (Direction, Accountability, Coordination & Control, Leadership, Innovation & Learning, and Culture & Climate). Three outcome scores were relatively healthier -- Motivation, External Orientation, and Capabilities. The Motivation outcome score is a top quartile score when compared to the global benchmark, External Orientation is a second quartile score, and Capabilities is a third quartile score.

In addition to comparing to the global benchmark, the NWS outcome level scores were benchmarked against scores of other public sector organizations and professional, scientific, and technical services organizations. When compared against these two sets of benchmarks, the Motivation outcome score was relatively stronger than both. In addition, two of the NWS outcome scores that were in the bottom quartile – Coordination & Control and Innovation & Learning – were relatively weaker than both sets of benchmark scores.

Exhibit 30: Results of Organizational Health Index (OHI)



The outcome scores were also compared internally across different levels within NWS, from respondents who self-identified as individual contributors versus senior leadership (Exhibit 31). Those responses indicate that there is a statistically significant difference between senior leadership (who manage other managers) and individual contributors (who do not manage others) in the overall perception of health, with senior leadership having a more positive overall perception of the organization's health. On certain outcomes – Direction, Leadership, and Culture & Climate – senior leadership had a more positive perception of health than individual contributors. For other outcome scores, there was more agreement, with both senior leadership and individual contributors perceiving those as being healthy (e.g., Motivation and External Orientation) or both groups perceiving those as being less healthy (e.g., Coordination & Control and Innovation & Learning).

At the practice level, 34 of the 37 practices were in the bottom quartile for organizational health, and several themes emerged when looking at the patterns of practice-level results. First, employees are highly motivated, as shown by the top quartile Motivation outcome scores, despite low scores at the practice level on Motivation. Second, employees say they lack clarity and buy-in around the vision and strategy of NWS, and feel they are not involved enough in the direction-setting process. Third, NWS is relatively externally oriented but does not often capture new ideas and quickly translate them into new innovation.

Exhibit 31: Senior level managers perceive higher outcomes

Benchmark

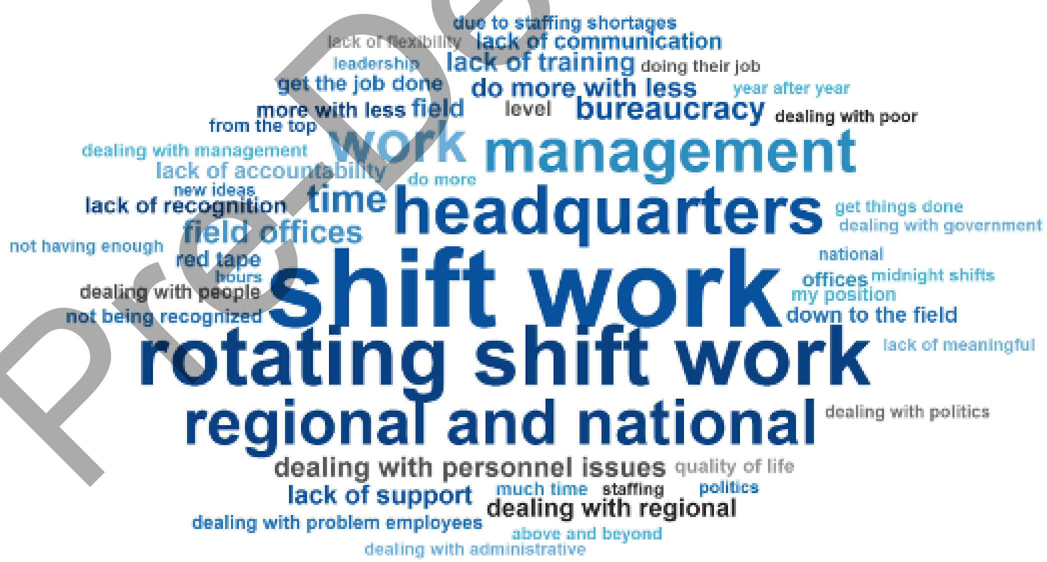
- Top Quartile
- Second Quartile
- Third Quartile
- Bottom Quartile
- Statistically significant at the 95% Confidence level

Percentage agreement on outcomes

	Responses	Overall	Direction	Leadership	Culture & Climate	Accountab-ility	Coordinat-ion & Control	Capabilit-ies	Motivation	Innovation & Learning	External Orientation
Individual Contributors: I do not directly supervise other employees	1680	51	48	49	45	50	30	73	69	27	68
Middle Management: I directly supervise other front-line employees	376	58	53	58	58	58	35	75	76	31	74
Senior Leadership: I directly supervise other managers	106	70	74	86	76	68	43	78	85	36	81
Difference between Senior Leaders and Individual Contributors		+19	+26	+37	+31	+18	+13	+5	+16	+8	+13

Additionally, staff reported dissatisfaction with the current rotational shift paradigm at the NWS. Staff report that midnight shifts in particular lower morale and adversely affect health. Staff also highlight difficulties working within the bureaucracy and with regional and national headquarters.

Exhibit 32: Organizational Health Index: Free text response to "What is the least rewarding part of your job?"



The OWA diagnostic identified numerous findings across workforce, operating model, and organizational structure, which NWS could address to improve its ability to deliver on the Weather-Ready Nation vision through IDSS. The next sections put forth a vision for the workforce, operating model, and organizational structure and ideas for moving towards that vision.

Vision for evolving NWS and achieving a Fully Integrated Field Structure

In light of the Phase 1 Diagnostic, NWS outlined a vision for improvements to its core science-based service "functions" (workforce, operating model, and organizational structure), as well as to its "form" (fully integrated field structure). In building the vision, OWA working teams and the Operations & Workforce Committee (OWC) governance body sought to create an inclusive process, involving internal and external stakeholders (e.g. IAEM, NEMA) and to balance the amount of change required with NWS's ability to act on that change. Project leadership aligned on several guiding principles to inform development of the vision and subsequent ideas, including:

- Continue the commitment to deliver on the mission through science-based service, with robust observing networks and accurate, consistent forecasts and warnings
- Maintain local presence, given proximity to core partners supports deep relationships IDSS
- Consider staff- and resource-neutral options and ideas; NWS may not be able to garner additional resources, and ideas involving staff reduction may not be feasible to implement

In response to the diagnostic and to enable the operating model improvements, NWS aligned on a vision for the NWS that moves:

- ***From* one-size-fits-all staffing levels at all offices *to* strategic staffing** that aligns staff based on workload demands, particularly partner needs
- ***From* a production-oriented workforce to a service-oriented workforce**, trained in the skills needed to serve partner needs and protect lives and property
- ***From* siloed field offices with overlapping roles *to* expertise aligned where it's needed most** through clear roles and responsibilities
- ***From* a "one-deep" operational force *to* field offices that support each other**, creating resiliency through more eyes on target and the capability to sustain surge operations
- ***From* cookie-cutter 24/7/365 operations *to* strategic operating hours** aligned to partner needs

NWS also aligned on a science-based service operating model with two foundational parts 1) deep relationships impact-based decision support services (IDSS) and 2) a collaborative forecast process:

- **Deep relationships IDSS** ensures NWS goes "beyond the forecast" to support partners in making life- and property-saving decisions related to weather, water, and climate events. The NWS does this by focusing its resources on core and deep partners who serve a critical public safety mission, by increasing consistency in services it provides, and by listening more deeply to customer needs. This allows the NWS to amplify its impact

- **Collaborative forecast process** ensures NWS provides weather, water and climate data forecasts and warnings for the protection of life and property and the enhancement of the national economy in the most efficient and effective way possible. The collaborative forecast process develops a single authoritative source for forecasts by layering national and local expertise onto a common starting point. By making the best use of technology, this process can reduce duplication and increase consistency

These changes culminate in a vision for a fully integrated field structure, with potential future footprint and staffing levels needed to deliver deep relationships IDSS, enabled by a collaborative forecast process. The fully integrated field structure could have:

- **Local offices serving as the tip of the spear for IDSS and WRN.** Local staff could be experts in partner needs, analysis and nowcasting, assessing the impact of weather and water events, and communicating those impacts to partners. Operating hours and staffing levels of offices could match partner needs.
- **Field offices supporting each other in filling gaps that can't be best filled at the national or local level**. Some offices could play an additional role in coordinating across local, regional, and national levels. Offices could work together more formally to provide resiliency and surge capabilities, to coordinate IDSS, and to support each other in research and training.
- **National offices (NCEP, OWP) delivering the initial single authoritative source for the forecast**, as well as analyzing impacts and providing IDSS for national partners. National centers could collaborate with other field offices, primarily through the Regional Operation Centers (ROCs).

Taken together, this vision evolves the NWS towards being a customer-centric organization, focused on delivering actionable information to partners in service of protecting lives and property. The vision for function and form changes – and the Fully Integrated Field Structure which delivers on the vision – have been tested with key stakeholders through briefings to Congressional members (e.g., authorizing committee), partner organizations (e.g., IAEM), professional organizations (e.g., NAPA/NAS), NWSEO, and staff.

IDEAS FOR EVOLVING NWS TO A FULLY INTEGRATED FIELD STRUCTURE

In order to deliver on the vision for evolving NWS to a Fully Integrated Field Structure, Phases 2 and 3 involved idea generation and refinement to address findings raised during the diagnostic and to define ways to implement the vision.

During this idea generation process, the OWA working teams, the Field Directors, and the OWC developed, analyzed, refined, and in some cases even tested ideas. Each working team (Workforce, Operating model, Organizational structure) contained field managers and NWSEO representation in order to ensure a representative balance of key stakeholders across the organization. These teams engaged in brainstorming sessions, interviewed subject matter experts, and surveyed their colleagues. Each working team presented their ideas to the OWC regularly, received guidance from senior leaders across portfolios and functions on these ideas, and then refined those ideas. At each OWC, Key Decision Points (KDPs) were considered to signal OWC support to continue working on these ideas. In some cases, namely the deep relationships philosophy and parts of the collaborative forecast process, the ideas were refined enough that the OWC recommended moving to testing and evaluation.

Throughout the idea generation process, OWA engaged the Regional Directors, National Water Center Director, and NCEP Directors (Field Directors) in developing and refining ideas.

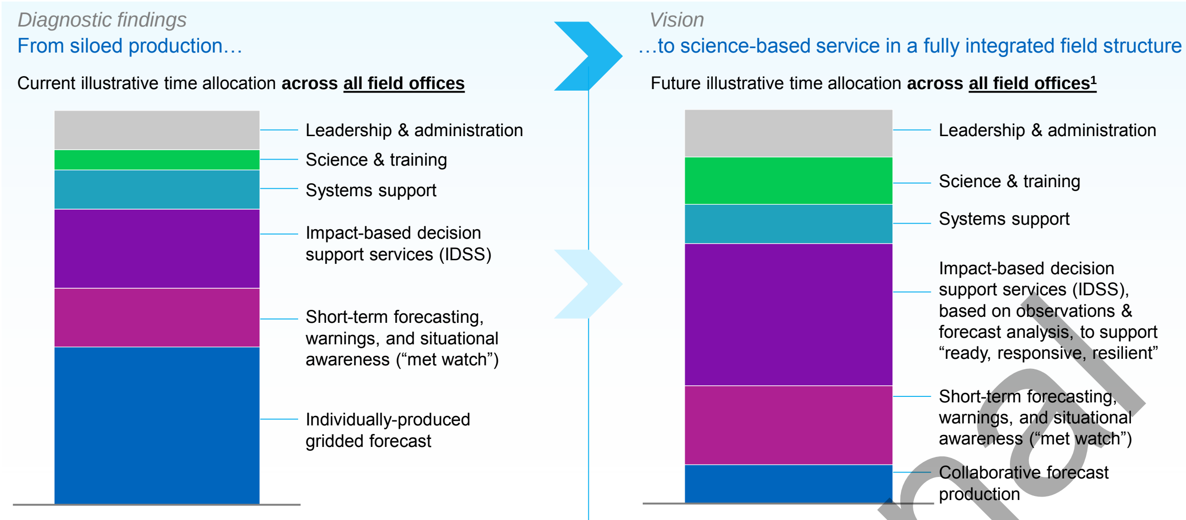
IDEAS ON WORKFORCE MODEL

Finding	Idea
There is a mismatch in some areas between workforce and workload	■ Strategically staff offices based on criteria that estimate workload
GS5-11 meteorologists are not fully developed and utilized in WFOs, and promotion to GS12 is inefficient	■ Develop NWS 101 onboarding program ■ Improve workforce training ■ Introduce internal rotation programs ■ Revisit federal qualification standards for key positions
There is a difference between current and desired skill level for IDSS	■ Develop NWS 101 onboarding program

Staff offices strategically based on criteria that estimate workload

Given the diagnostic findings on the workforce-workload gaps, as well as the commitment to the deep relationships IDSS philosophy, the OWA Fully Integrated Field Structure and Field Director teams developed ideas for aligning staff resources according to workload, including demand for IDSS. The Field Director team developed a blueprint for determining staffing levels for offices based on the functions they could perform according to the vision.

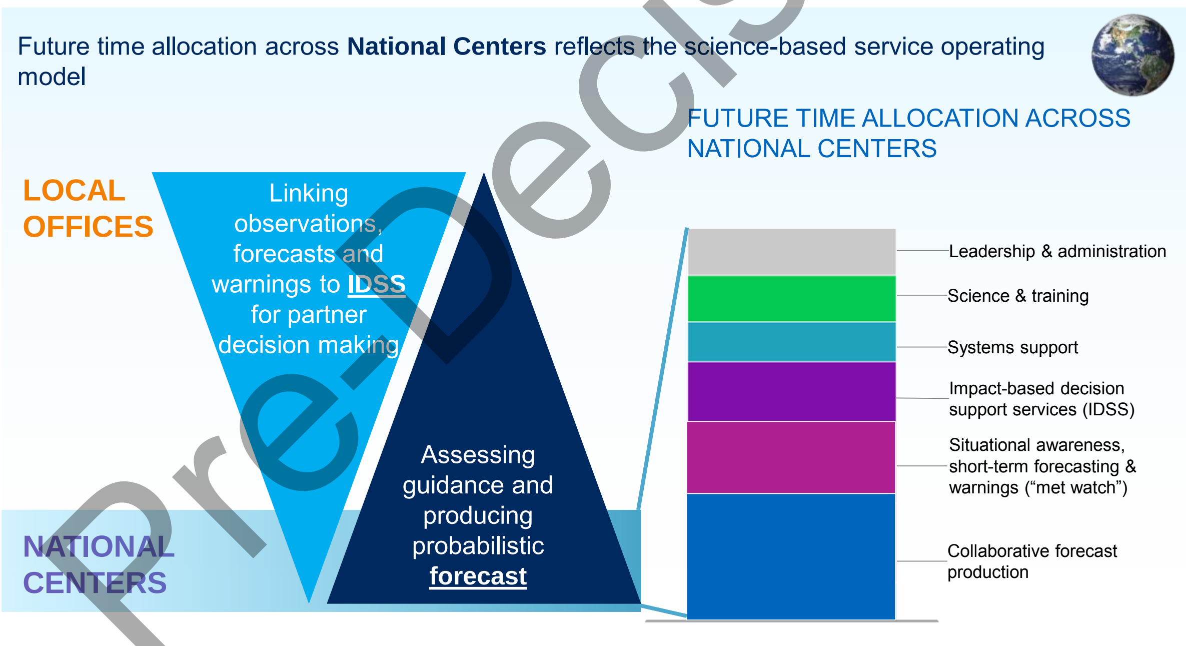
Exhibit 33: Blueprint for strategic staffing across all field offices



1 Chart represents an average time allocation across all field offices, including WFOs, RFCs, CWSUs, RHQ, ROCs, NCEP, NWC – time allocation at each office will be different according to the focus of each office in support of a Fully Integrated Field Structure
SOURCE: Interviews and job shadowing during ~40 office site visits from May 2015 – January 2016, OWA IDSS team, April 2016

The blueprint, as shown in Exhibit 33, outlines the major functions of the field, and indicates conceptually how the balance of staff time could be spent in the future.

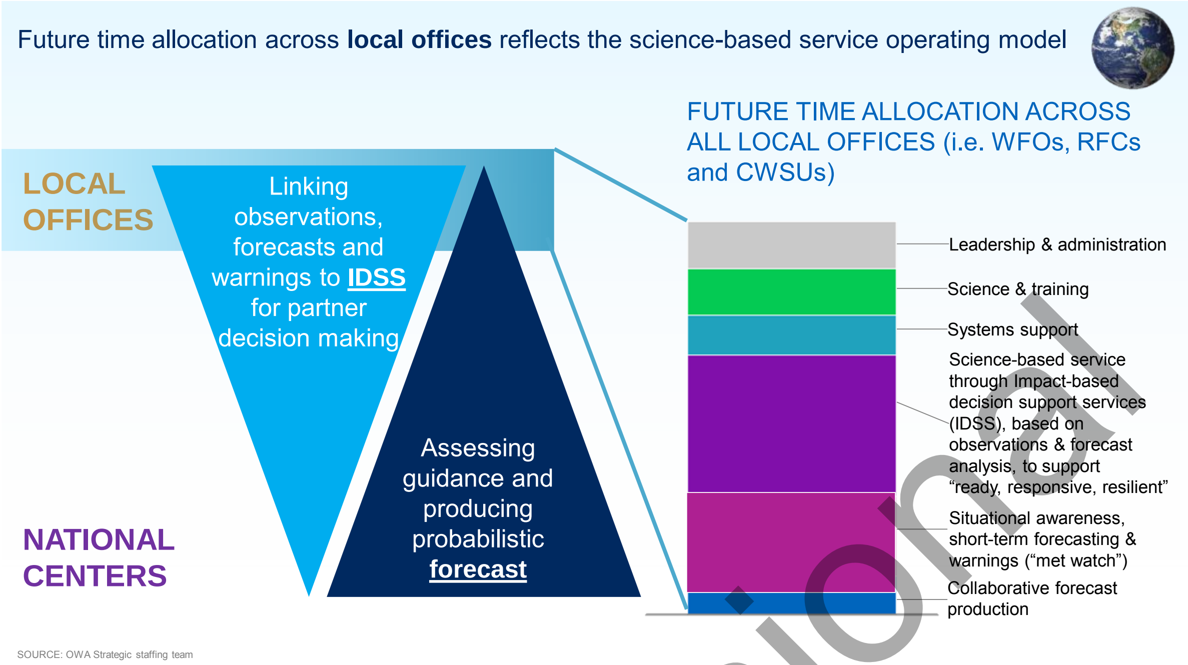
Exhibit 34: Blueprint for strategic staffing at National Centers



SOURCE: OWA Strategic staffing team

The National Centers, given an increased focus in the future on collaborative forecast production, would have an allocation of time similar to Exhibit 34.

Exhibit 35: Blueprint for strategic staffing at local offices



The local offices, given an increased focus in the future on science-based service, would have an allocation of time similar to Exhibit 35.

For local offices, the size of each function and each office could be determined by assessing workload in that office's area of responsibility.

- IDSS: Dimensions to assess could include 1) people and property, 2) weather types, 3) weather frequency, 4) vulnerability, and 5) presence of core and deep partners. The dimensions could balance quantitative indicators of demand, such as population, GDP, and hazard information, with qualitative factors, such as unique aspects of the population or geography or how decisions are made for that area.
- Met watch: the need for and size of a dedicated met watch function could be determined by assessing the frequency of activity in the area and if another office could provide met watch for a group of offices.
- Systems support: the number of and distance between radar sites, ASOS sites, COOP sites, and autolaunchers could inform the number of staff needed at each site. The level of IDSS activity in the area could also influence the number of systems support staff needed, as IT and electronics staff could provide the infrastructure support needed to collect and share data and maintain communications.
- Science and training: The size of the science and training function could vary with size of the office overall and whether the office provides support to other offices. Offices located near key research partners (e.g., other NOAA offices, universities) could have dedicated research managers; these research managers could coordinate efforts across WFOs to participate in research projects.

Similarly, some offices could have dedicated training managers who could provide support across WFOs.

- Leadership and administration: The number of managers and supervisors in the office should scale with the size of the office overall, targeting a span of 6-10 direct reports per supervisor to allow for coaching and development. Administrative staff could also scale with office size.

OWA first focused on staffing levels at WFOs, given the findings on the workload-workforce gap among 1340s and that there was already asymmetry in RFC staffing. A similar analysis could inform staffing levels at additional field offices.

Create a GS 5-12 meteorologist career progression

In addition to staffing levels, OWA developed ideas for addressing the skill gap at WFOs and the challenges of the current GS 5-11 position, chiefly through an updated competency model for meteorologists and a unified career progression for GS 5-12 1340 meteorologists. Currently, employees advance based on time in grade alone, making it difficult to ensure necessary skills are demonstrated. GS 5-11 meteorologists are underused today, and promotion to GS12 requires costly hiring actions.

The core team, along with their OWC champions, developed a framework that added training, experience and satisfactory performance reviews to the time in grade standard. Training at each grade level could be a mix of mandatory and elective trainings, chosen from a broad library of classes to satisfy employee career interest and class availability. Employees could also be expected to fulfill a set number of hours of “experience,” which could range from FAM visits to skills demonstration.

An updated competency model was designed to capture the critical skills needed for IDSS, both in terms of the science and the service. Hiring, performance evaluation, promotions, and trainings could all be aligned to this model.

Exhibit 36: Dimensions of GS 5-12 competency model

Dimensions	Definition
① **Info. mgmt., data collection, and quality control**	Collects, analyzes, interprets, and applies data from environmental observational systems. Manages environmental data systems and uses applications for real time and/or historical data analysis
② **Forecast and warning generation**	Diagnoses the environment to assess and adjust forecasts and issues appropriate watches, warnings, and advisories within a collaborative inter-office framework
③ **IDSS**	Develops trusted relationships, captures external needs, and provides actionable information and interpretative services to enable partners' decisions when weather, water, or climate has a direct impact on the protection of lives and livelihoods
④ **Management, teamwork and leadership**	Collaborates and co-creates with colleagues to create impact, leverages talents of other stakeholders and colleagues, develops ownership of individual work, and influences others. Effectively understands roles and responsibilities of position
⑤ **Integration of science and technology**	Demonstrates expertise in the theory of weather, water and climate sciences, is up-to-date on latest scientific and technological developments, and provides science-based and technology-based solutions to operational challenges

Exhibit 37: Competencies overview

Title of each competency

Info. Management, data collection and quality control	Forecast and warning generation	IDSS	Management, teamwork and leadership	Integration of science and technology
Collecting data, observations, and information	Diagnosing the environment	Developing and maintaining trusted relationships	Exhibiting teamwork	Development of scientific skillsets
Managing information and ensuring quality control	Assessing and issuing scientifically-sound environmental forecasts	Understanding partner impacts and needs	Leading others	Continuing technical development
	Developing and issuing hazardous environmental information and alerts	Demonstrating situational awareness	Leveraging diversity and respecting others	
		Developing and delivering effective written and oral communication to link forecast information with decision making	Managing programs	

Develop "NWS 101" onboarding program

In Phase 3, the core team focused on refining a proposal for a universal, in-residence onboarding course called NWS 101. The course could ideally be offered to all new employees, regardless of seniority or function, and could focus on the NWS's role within federal government, the NWS's organizational structure, NWS's mission and culture. The core team identified the benefits and risks associated with the course, projected costs and suggested next steps for continued development.

The Office of the Chief Learning Officer adopted this idea and developed an NWS 101 onboarding program. The first class was held in August of 2016.

Exhibit 38: NWS 101 concept

Description of Investment

1. **Local office training could include online and on the job training**
2. **An in-residence NWS 101 training could include:**

- **Gov 101** – an overview of DOC, NOAA and NWS role within the larger organization
- **NWS org. structure** – an overview of the NWS' budget, governance, requirements and policy processes
- **NWS mission & culture** – an introduction to NWS' mission, history, vision (including IDSS) and culture
- **Team building** – an introduction to team work, collaboration and communication at the NWS

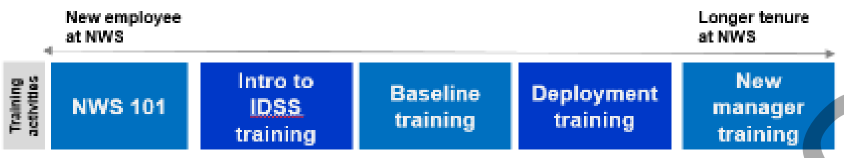
- **All hires new to the NWS would participate**[1]. A diverse class of varying seniority and job functions from different offices will help lead to sharing of ideas and a more open and trusting environment
- **Training could be offered 4 times per year for one-week or more.** On average ~133 new NWS employees are hired per year, which would allow for class sizes of ~33 people per quarter
- **Lecturers could be drawn from across the organization.** Experienced / seasoned staff could be drawn from across the organization to speak to their specialty or lead breakout groups, potentially fulfilling one of their own IDP goals

3. **Role specific training could include in-residence, online, and/or on the job training; in addition strength assessments could be administered, which would inform individual dev. plans (IDP)**

Improve workforce training

Increased deep-relationships IDSS training and new MIC/HIC training were recommended by the OWA core teams as potential means of addressing workforce skill gaps. When paired with NWS 101 and the existing baseline training curriculum, these courses together would comprise a unified training journey for NWS employees (Exhibit 39).

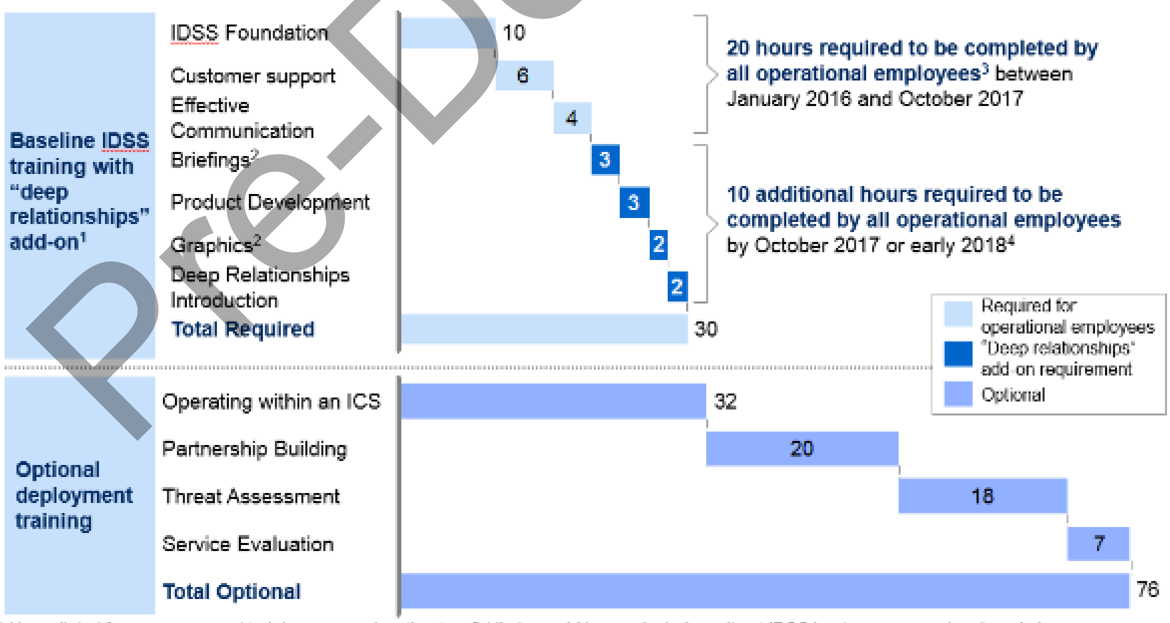
Exhibit 39: Proposed NWS training journey for Meteorologists



The core team outlined several proposals for increasing and supplementing IDSS training in support of implementing a deep-relationships approach to service provision. IDSS Professional Competency Units had been developed (or were in development) prior to the OWA, but the core team identified additional needs to be incorporated into the training, particularly in familiarization with the deep-relationships philosophy, as well as additional skill training in product development, graphics, and briefings (Exhibit 40).

The core team also developed proposals to standardize "Deployment-ready" certifications and the training process by which staff can achieve them, in addition to outlining the potential content of a broader "Intro to IDSS" module for all NWS employees (not just meteorologists) focused on the "why" behind IDSS.

Exhibit 40: IDSS training and suggested additions



1 Hours listed for new, proposed training are rough estimates; 2 Likely would be conducted on-site at IDSS bootcamps or regional road shows
3 Approximate number of operational employees is 2,300: 15 per WFO, 10 per CWSU, RFC, and NCEP
4 Exact timing for development, roll-out, and required completion date for new courses is not yet certain

As part of the Phase 3 recommendations, the core team proposed a new manager orientation course specific to MICs and HICs as a way to improve the leadership skills of the immediate supervisors of 60% of the NWS's workforce. New manager training could build on previous supervision and management courses, and focus on developing specific skills in organizational leadership, including strategic planning for the office, how to lead service delivery in a deep-relationships IDSS framework, and field integration (Exhibit 41). If offered on a semi-annual or annual basis, cohort sizes could average ~6-12 managers per course.

Exhibit 41: Potential benefits of new MIC/HIC training

Benefits to the NWS

Protect life & property

- **Mission focused.** Employees will know the mission, understand their role in protecting life and property, and be better prepared to help achieve a WRN from day one

Serve core partners

- **IDSS centered.** Uniform, introductory training on IDSS will help new employees understand the purpose of IDSS through serving core partners

Improve org. health

- **Team orientated.** Emphasis on team building and collaboration will help create a positive working culture
- **Organizationally integrated.** Employees will see how their work fits into the nationwide organization, which will help lead to an integrated field structure
- **Professionally connected.**[1] New employees will have the chance to build a cross-agency network right away

Steward gov. resources

- **Ready to succeed.** Onboard training will help to make new employees advance on the learning curve more quickly so that they can be more productive
- **Career orientated.** With a perspective of the entire organization and professional development opportunities available throughout their career, employees will be able to more easily envision their potential future career path

Introduce internal rotation programs

The OWA core team also identified internal rotational programs as a means of both further building staff capabilities and developing more trust and cohesion across parts of the organization. A range of possibilities were explored, from simple working rotations of forecast staff from one WFO to another (potentially in another region, or to a location with robust IDSS capabilities), to ROC duty-officer rotations (as are currently in place in Southern Region), to more intensive rotations through NCEP or HQ as part of leadership development in advance of promotion to management (for example).

Revisit federal qualification standards for key positions

The OWA core team also noted inconsistencies between the language of current federal qualification standards and the skillset required of meteorologists in present NWS. Most notably absent are any specific qualifications or experience relating to communication, decision-support, or customer service. Subsequent efforts from Workforce teams could focus on balancing the language of the qualification standard toward social science and interpersonal skills, in addition to a continued robust emphasis on physical science skills.

IDEAS ON OPERATING MODEL

Finding	Idea
IDSS matters to NWS partners, who say IDSS helps improve their decision-making	■ Continue to define IDSS and how NWS can become a customer-centric, science-based service organization, via "deep relationships" IDSS
IDSS is delivered inconsistently and to varying degrees today	■ Establish common partner definitions ■ Establish standard service levels for IDSS ■ Build reporting, accountability, and coaching mechanisms to support all MICs/HICs in achieving standard service levels
The forecast process has some duplication of effort, does not make best use of local staff time, and can result in inconsistent forecasts	■ Develop a collaborative forecast process that leverages technology (e.g., NBM) and reduces grid editing ■ Produce gridded forecasts for larger CWAs where possible

Continue to define IDSS and how NWS can become a customer-centric, science-based service organization, via "deep relationships" IDSS

The vision for "deep relationships" IDSS draws on examples from the NWS field today, where local offices have developed innovative ways to serve partners and protect lives and property. OWA has worked to identify best practices and elevate examples of what works based on leadership from the field – and then codify and spread that approach consistently across the field. Two examples below illustrate what IDSS means to NWS partners.

IDSS in action: Red River flooding in Fargo

The Red River in Fargo ND has become increasingly prone to devastating floods over the past 15 years. After severe flooding in 2009, Tim Mahoney, the Deputy Mayor of Fargo challenged the emergency management community to improve the city's response to such events: "In the flood fight of 2009, we did 3.5 million sandbags in nine days. We were trying to get ahead of that this time and have people start to get things ready for us in advance."

The NWS responded by deepening its relationship with the US Army Corps of Engineers and local and State Emergency Managers, and conducting more in-depth training, exercises, briefings and outlooks in advance of flood season. In the 2011 flooding, they deployed meteorologists and hydrologists as part of an inter-agency river surveillance effort, allowing for increased frequency and reliability of river forecasts. The information provided by the NWS was used to determine the location and scale of temporary levees, and coordinate reservoir releases to mitigate the impact of flood waters, resulting in millions of dollars saved. Extensive after-event reviews were conducted to ensure that the lessons learned from the deployment model could become standard operating procedures for subsequent events.

IDSS in action: Dense sea fog in Tampa Bay

The hazards associated with dense sea fog are particularly salient to folks in Tampa Bay, FL after a tragic collision in 1980 between a seagoing freighter and the Sunshine Skyway led to the collapse of a span and a loss of 35 lives. As such, the NWS takes fog in the area very seriously, and partners closely with the US Coast Guard, area ports, and local law enforcement to ensure safety-at-sea when visibility deteriorates.

In a recent event, a cold front stalling in the area resulted in a fog bank persisting for three days, enveloping the community in dense fog. Recognizing the potential impact of this kind of event, the NWS had exercised extensively with local partners, and was therefore ready to escalate the flow of information to its partners as the situation developed. Once the fog had settled in, a steady tempo of briefings kept partners apprised of location, thickness, and possible areas of clearing of fog, and advisories were issued to help law enforcement communicate the hazard to motorists and boaters. This steady flow of high-quality information allowed local authorities to set up special traffic alerts, close affected roadways, and halt marine operations until conditions improved. After the fog cleared, the NWS continued to support the USCG in follow-on Search-and-Rescue operations, and conducted extensive after action reviews.

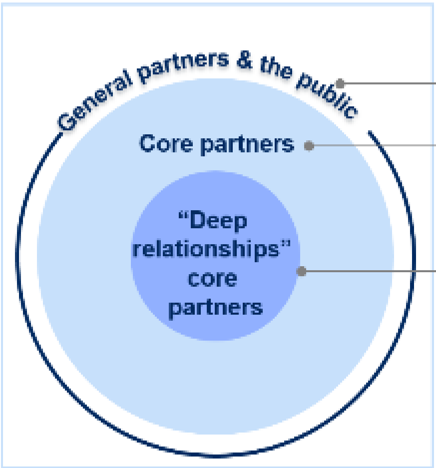
The NWS should continue to highlight and celebrate examples of good, deep-relationships IDSS in practice in order to build a consistent cultural understanding of what it means to be customer centric.

Establish common partner definitions

The IDSS team developed ideas for improving delivery of IDSS through a more consistent approach to defining who receives IDSS and what constitutes IDSS. Work is ongoing to define how and when IDSS should be delivered through a standard operating model.

In defining who should receive IDSS, the team developed three categories of partners: general, core, and deep core. The partner categories correspond to the level of decision-making the partner has in the community: partners who are an active part of the emergency management community fall in the **deep core partner** category; partners who help prepare or disseminate information about weather hazards fall in the **core partner** category; and all others are in the **general partners and the public** category, making decisions governing only themselves as individual entities (Exhibit 42).

Exhibit 42: IDSS partner categories



Partners that fall outside of the core partner definition, e.g. general public, private businesses

Government and non-government entities which are directly involved in the preparation, dissemination and discussions involving hazardous weather or other emergency information put out by the NWS1

"Deep relationship" core partners are a subset of core partners that are members of the emergency management community or are government partners with NWS nexus. Offices determine their "deep relationship" core partners according to criteria:

- Pertain to **legal or national security** responsibilities
- Exercise a **large degree of authority or influence** on public safety relative to other core partners
- Serve a **population or entity particularly vulnerable to weather**
- Act as a **force multiplier to help amplify NWS message**

Level of impact based DECISION-SUPPORT provided MATCHES THE LEVEL OF DECISION-MAKING OF PARTNERS

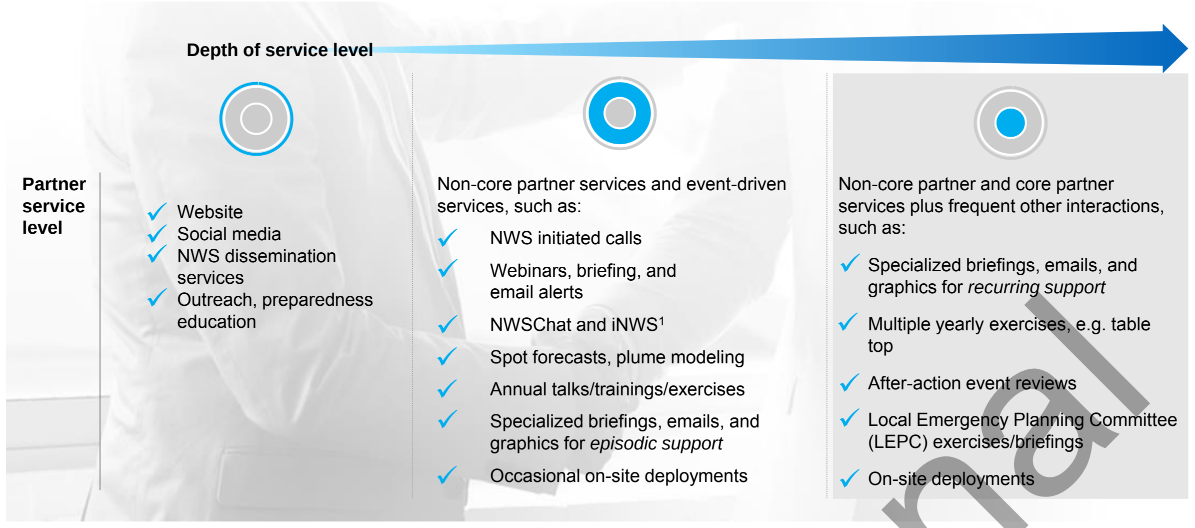
The IDSS team has taken an iterative approach to determining which partners would be served, at which level. In addition to developing a Public Notification Statement on the potential deep relationships IDSS policy, the IDSS team engaged all NWS field offices in an exercise to determine core and deep partner relationships, the results of which will be used to establish an initial baseline dataset on partners that can be used to compare the current state across offices and further refine partner type definitions.

Establish standard service levels for IDSS

The IDSS team has also developed ideas for the service levels each type of IDSS partner could receive. Deep relationship partners receive the most customized products and services and the highest level of support, ranging from tabletop exercises and preparatory activities multiple times a year, to in-person, on-site support during a response (Exhibit 43).

The IDSS team also developed an IDSS planning framework that would help MICs/HICs structure their IDSS activities for any given year. The framework would consist of a planning template and supporting guidelines and materials for MICs/HICs to use in planning for and delivering IDSS to a common service level.

Exhibit 43: IDSS partner service levels



1 Media should only receive non-core services plus first three listed core partner services

Build reporting, accountability, and coaching mechanisms to support all MICs/HICs in achieving standard service levels

Along with establishing standard service levels, the NWS could develop systems to provide initial and ongoing support to field offices in developing, sustaining, and continuously improving their capabilities to deliver IDSS.

First, the NWS could develop an accountability mechanism for tracking, measuring, and reporting IDSS activity that would be shared with senior leadership and/or included in performance reviews. This mechanism would incentivize MICs/HICs to track their IDSS activities in a log or database throughout the year. With national IDSS information saved in one database, the NWS could measure national IDSS activities and benchmark across offices to identify best performers and those that need more support to deliver IDSS. Over time, this would help achieve a more uniform level of IDSS across the entire organization, as well as facilitate the sharing of best practices among peers.

Along with a formal accountability system, a more formalized set of support activities could help develop the IDSS capabilities of all MICs/HICs (Exhibit 44). The NWS could consider establishing IDSS working groups, where several offices get together in small groups or clusters to discuss their IDSS plans before submitting to senior leadership. Similarly, rotational assignments could allow forecasters to visit other offices and share their best IDSS techniques and practices. In certain cases, on-the-ground diagnostic reviews could be utilized to provide extra support to MICs/HICs who require additional IDSS training. These type of support activities and others could provide venues for MICs/HICs to share best practices across the organization and would ultimately help create a standard level of IDSS across the nation.

Exhibit 44: Potential spectrum of IDSS support activity (developed by OWA IDSS team in Mobile, AL)

Low-touch → High-touch

Support activity	Internal diagnostic	Working groups / clusters			Rotations	Workshops	Diagnostic reviews
		Local	Regional	National			
Description	MICs/HICs to track metrics / diagnostics in a log/database that help them self-assess their IDSS and provide an open and transparent view of their metrics to other offices. This allows field offices to compare to their cluster, Region and National. Also should include partner input.	Working teams with surrounding offices or within / same cluster to act as a peer-to-peer support / coaching mechanism for field managers	Working teams with offices from within the same region (but not adjacent) to act as a peer-to-peer support / coaching mechanism for field managers	Working teams with offices from across regions to act as a peer-to-peer support / coaching mechanism for field managers	Rotational staff assignments / sending forecasters to other offices to share best practices. Would involve National, Regional and local staff	Host office workshops at field offices focused on improving the IDSS capabilities where new ideas / techniques are shared	Comprehensive review of IDSS programs. Interview MICs on-the-ground that either require additional support or have excellent IDSS that we'd want to learn from. Also should include partner input.
Who	All	Field manager clusters	Region clusters	National clusters	All	National	National
How often	Continuous	Monthly	Quarterly	2x yearly	2x yearly	2-3 years	Annual/4 years

Develop a collaborative forecast process that leverages technology (e.g., NBM) and reduces grid editing

The OWA team has developed ideas to increase collaboration in the forecast process with the dual aim of improving forecast quality and reducing duplication of effort across field offices. The collaborative forecast process could begin with a single starting point for all field offices and allow for the layering of expertise from the national level to the local level; all offices could use a common operating picture. The result of the collaborative forecast process could be a single authoritative source of forecast information for all staff to use and to distribute to partners.

Exhibit 45: Collaborative forecast process vision

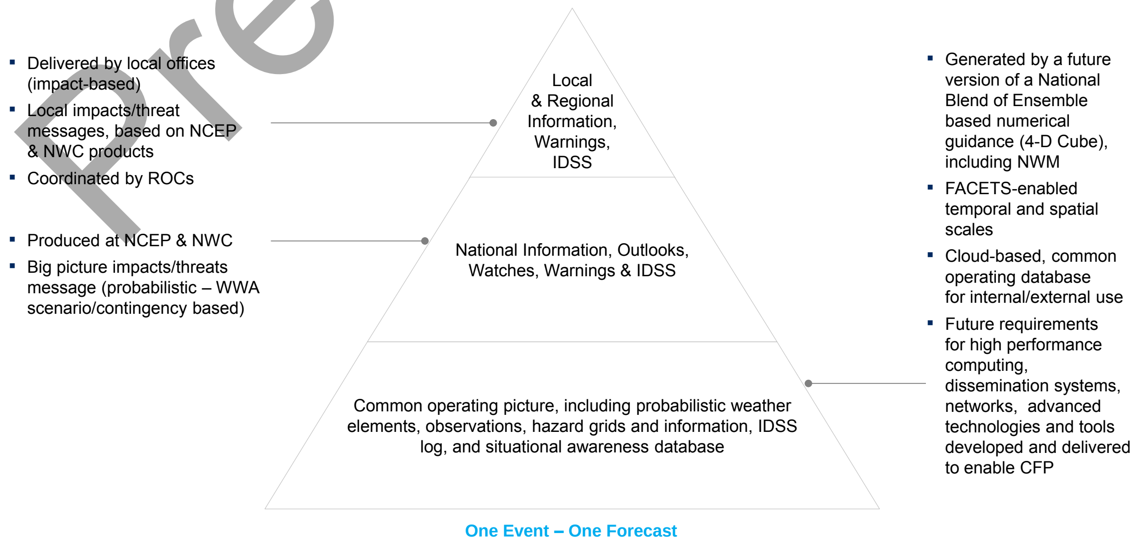
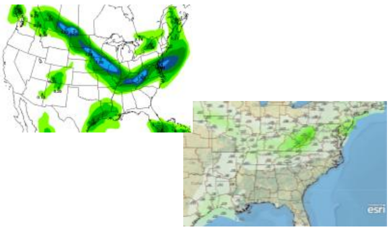


Exhibit 46: From-to on forecast process

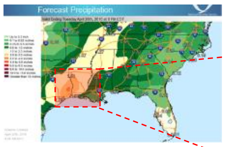
From multiple forecasts and a "patchwork" quilt



- WFOs, RFCs, and NCEP overlap at times resulting in **inconsistent forecasts and duplicated effort**
- Many forecasters **manually determine which models to use**
- Forecasts **may contain "seams"**
- Each office is **not fully leveraging all the expertise NWS has to offer**

To a common operating picture

Products at national scale…



- Produced at NCEP & NWC, based on the National Blend of Models and National Water Model
- Focused on big picture impacts and threats message, increasingly probabilistic

…that allow for local detail to be added

- Local detail added as needed for IDSS
- Focused on local impacts and threat messages, based on NCEP & NWC products and national models

The goal is one event, one forecast – because multiple forecasts is no forecast at all

In the long-term, this forecast process could be highly automated, with model information updating rapidly and meteorologists at all levels "over-the-loop" providing quality control and interpreting probabilistic weather information to identify hazards and communicate to partners.

In the short-term, while model guidance is not yet skilled enough or is still under development, the OWA team has developed and identified several ideas that are already underway within the organization for improving the forecast and reducing duplication in the forecast process. Centers such as WPC and AWC, that currently have significant overlap of duties with forecast offices, could produce initial "first-guess" grids based on the National Blend of Models, or a proxy blend. Then, the gridded forecast information could be shared with WFOs for further improvement, whether through direct edits or through submission of concerns. Over time, edits to incorporate local effects could be incorporated automatically through post-processing, or through improved model guidance.

The forecast process team, as well as the National Blend of Models teams, are developing ideas for tests and demonstrations that could help inform roles and responsibilities related to the forecast process. At the time OWA was developing ideas, AWC, through its Digital Aviation Forecasting initiative had already begun developing a similar idea.

Produce gridded forecasts for larger CWAs where possible

An additional idea to improve the forecast process is to enable offices to forecast across multiple WFO areas of responsibility where there would be consistency and/or efficiency benefits. Given a common starting point across offices, fewer staff members in a given area (for instance, a state) may be needed to adjust the forecast to meet partner needs. In particular, as the organization evolves to take advantage of a more automated forecast process, forecasting for larger areas could provide a bridge until model guidance is strong enough to relieve WFOs of gridded forecast production responsibility.

IDEAS ON ORGANIZATIONAL STRUCTURE

There is a lack of role clarity between the newly reorganized National Service Programs (NSPs) and the National Centers for Environmental Prediction (NCEP), as well as inconsistencies in NCEP roles and responsibilities	■ **Improve NSP program role clarity** ■ **Develop common NCEP operating model**
There is a lack of role clarity between River Forecast Centers (RFCs) and the Office of Water Prediction/National Water Center (OWP/NWC)	■ Clearly define roles for RFCs and OWP/NWC in the forecast process and IDSS ■ Reevaluate reporting structure of RFCs
Staff in WFOs do not have sufficient time or flexibility to deliver IDSS due to current responsibilities, cookie-cutter staffing, 24/7 requirement, and requirement of 2 people per shift	■ Unlock time for strategic staffing through function and form changes
Some current WFO functions are not most effectively delivered within an individual office	■ Establish formal mechanisms for offices to support each other
Span of control for field managers is too high	■ Develop additional supervisory positions
NWS's organizational health is not sufficient to support performance	■ Focus on priority practices such as role clarity, capturing external ideas (innovation), and creating an open and trusting environment

Improve NSP role clarity

The organizational core team developed a number of options to increase role clarity between the NSPs, NCEP, and the broader field structure. Options included: 1) employing NSPs as policy aggregators across the integrated field, 2) allowing NSPs to directly oversee and set policy requirements for the field, and 3) disbanding the NSPs and instead using NCEP to set policy and operational requirements.

The OWC directed the core team to further refine option 1 – employing NSPs as policy aggregators across the integrated field – in Phase 3, which led to the guiding principles and distribution of functions outlined in Exhibit 47.

The Analyze, Forecast, and Support Portfolio within the Chief Operating Officer's Office is now considering options for addressing NSP role clarity.

Exhibit 47: Ideas for NSP roles

Guiding principles:

- **The National Service Programs (NSPs)** focus on strategy, planning and policy – providing support to and serving the field, acting as a check and balance against desired requirements & budget constraints, & raising issues to the Mission Deliver Council when appropriate
- **The integrated field offices** are operationally focused on mission delivery – providing products and services, such as analyses, forecasts (IDSS), forecast warnings, observations and infrastructure

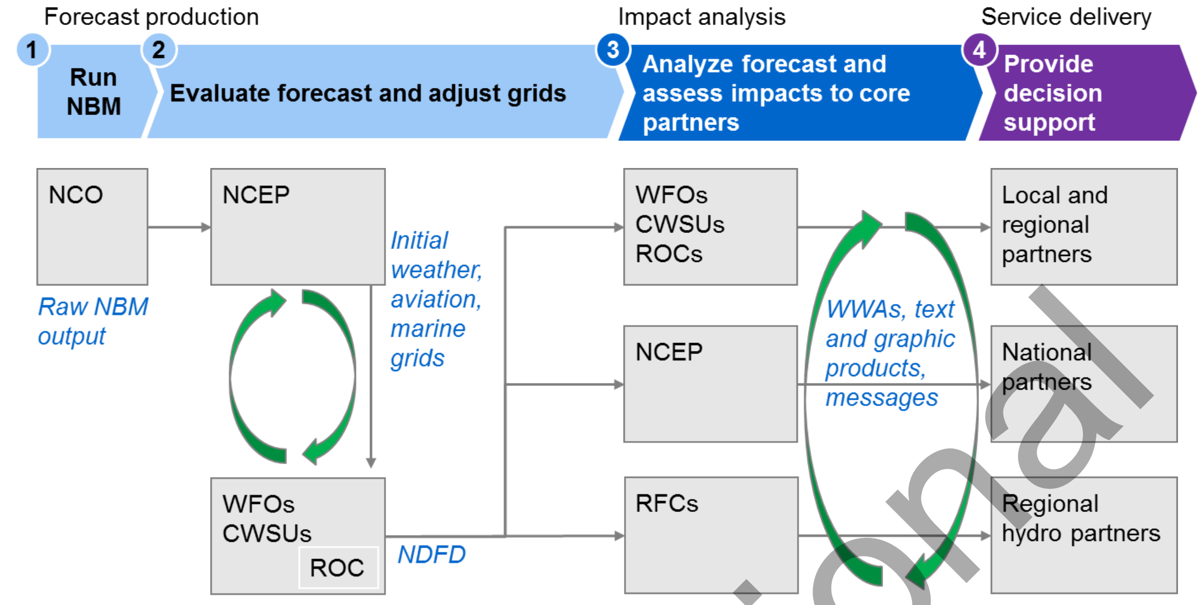
Functions	National Service Programs (NSPs)[1]	Integrated Field
Strategy	▪ Coordinates strategy with the field	▪ Proposes strategic objectives
Requirements	▪ Aggregates needs & proposed reqs. from internal & external partners & stakeholders, to conduct evidenced-based trade-off analysis, serving as an impartial broker	▪ Proposes needs and requirements based on input from core partners
Planning	▪ Leads NSP long-term planning (e.g., 3-years), with a focus on their entire service program	▪ Focuses primarily on execution year, and collaborates with NSPs to develop 3-year plans
Budget	▪ Advises AFSO director on mission critical needs of programs with input from the entire field	▪ Advises respective directors (e.g., RDs, NCEP Director) on budget needs
Policy	▪ Proposes and develops national policy based on requirements	▪ Implements and enforces policy which is based on requirements
Accountability	▪ Held accountable by AFSO director, who reports to the COO	▪ Held accountable by respective directors, who collaborate with the AFSO & report to the COO
Knowledge sharing	▪ Provides forum for feedback loop regarding policy & planning for the entire field	▪ Provides technical and operational expertise – including best practices
Organizational perspective	▪ Provides high-level view of entire field and across the NSPs	▪ Provides technical and operational expertise – including core partner knowledge

Establish NCEP as developing initial single authoritative source for forecast

The collaborative forecast process puts forth a vision in which expertise is layered onto a common starting point (the National Blend of Models). An idea for how this process could flow in practice is for NCEP to develop an initial, single authoritative source for the forecast (particularly once the National Blend of Models is probabilistic), which is then sent to WFOs for review and refinement at more local levels, particularly in the short-term time ranges, as needed for IDSS.

This very high level process flow outlined in Exhibit 48 would have to be refined for use across service areas but serves as an initial idea of how a collaborative forecast process could work.

Exhibit 48: Idea for process flow in collaborative forecast process



Develop NCEP common operating model

As part of the collaborative forecast process and idea, the OWA team has also considered how NCEP service Centers might follow a consistent business model. The vision for a collaborative forecast process puts forth that the Centers provide watches and outlooks, while WFOs provide warnings, unless there is a case for building a national warning capability (such has been done with hurricanes). As collaboration becomes more critical across field offices, the Centers could develop a consistent set of tools for collaboration and protocol for setting up collaboration calls and incorporating feedback.

Align Tsunami Warning Centers operationally and consider broader changes to program delivery

The organizational structure working team developed a number of structural options to improve alignment of the tsunami warning centers (TWCs), including aligning the TWCs under NCEP, having the TWCs report directly to the COO, or aligning the TWCs under another NOAA line office. The OWC directed the core team to consider additional options under the current organizational structure – where the TWC report to their respective regional directors, who in turn report to the COO – since the COO position and office are still relatively new.

Currently, the two TWCs issue forecasts for their respective areas of responsibility, meaning a single seismic event leads to two forecasts, which may not be consistent with one another. To address this issue, in Phase 3 the core team identified a number of actionable ideas, including: integrating IT systems, defining "operational watch" for the two centers, providing forecasts for the full Pacific basin, defining the Caribbean basin as a single AOR, and formalizing structures to increase collaboration between the two centers. The core team also identified three alternative long-term paths for the centers: rotate between hot and warm status, so only one issues a forecast for any given event; consolidate the centers; or have one center specialize in forecast issuance and the other specialize in education and outreach.

The NWS Executive Council is continuing to discuss and prioritize the long term options, while the Office of the Chief Operating Officer is pursuing the actionable ideas.

Clearly define roles of RFCs and OWP/NWC in the forecast process and IDSS

OWA has worked closely with leaders and managers of the NWS water services program, including the NSP program lead, the Director of the OWP, regional water program managers, and several RFC managers to develop ideas for the roles and responsibilities at RFCs and the OWP/NWC. Through a series of working sessions, this water services team has developed initial ideas on IDSS responsibilities and a collaborative forecast process as they apply to the water program. RFCs could continue to play a vital role in managing the forecast process by providing the link to anthropogenic information needed in the National Water Model and by providing IDSS to more regional core and deep partners, as well as subject matter expertise for staff in WFOs and their partners.

Exhibit 49: Idea for local, regional, national IDSS alignment

✓ Very frequent provider of IDSS (✓) Somewhat frequent provider

	Who are the partners?	What are the decision needs?	Where could the IDSS occur? WFO	RFC	Region/ ROC	National
Emergency management and support	Local or county EMs[1]	Event-driven support (Inundation maps[3], resource placement, advising on emergency constructions and hydraulics/scenarios, containment transport); Recurring (pre-event planning; outlook basis. Planning piece; post-event	✓	✓	(✓)	
	State EMs[2]		✓	✓	(✓)	
	Local presence of national partners (e.g., FEMA region)			✓	✓	✓
	National partner HQ (e.g., FEMA)					✓
	National partners (USGS, Army Corps of Engineers)			✓	✓	✓
	International partners (e.g., International Joint Commission)		✓	✓	✓	✓
	Dam operators, floodplain managers, levy districts	Event-driven support; In-flow forecasts (lengths vary); Scenario planning and training	✓	✓	✓	
Water supply, management	Watershed districts	In-flow forecasts (lengths vary); forecast low flow as well; with uncertainty	✓	✓		
	State water resource managers		✓	✓		
	Reservoir managers		(✓)	✓		
	National partners (US Bureau of Reclamation. USGS, Army Corps of Engineers)			✓	✓	✓
Transportation	River navigators	In-flow forecasts and velocity; River ice analysis	✓	✓		
	Transportation agencies (DOTs, roadways, railways)	Inundation maps	✓	✓		
Utilities	Plant operators (e.g., hydro, nuclear)	In-flow forecasts of various lengths (e.g., 12 days for nuclear)	✓	✓		✓
	Large operators (e.g., TVA)			✓		✓

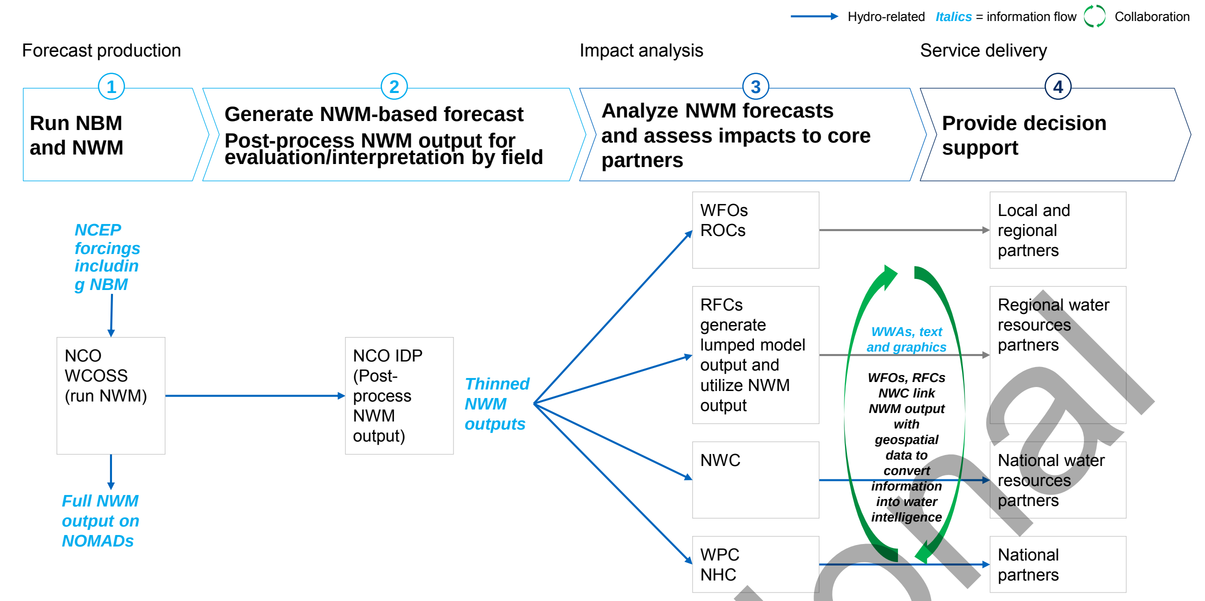
1 May include international partners at a local level (e.g., counties in Canada); in some places, will be boroughs or parishes;2 May include international partners similar to state level (e.g., Canadian provinces); 3 Inundation mapping includes time of flood and peak flood, duration, confidence, and worst case

✓ Very frequent provider of IDSS (✓) Somewhat frequent provider

	Who are the partners?	What are the decision needs?	Where could the IDSS occur? WFO	RFC	Region/ ROC	National
Water policy, planning, and community resiliency	National partners (e.g., National Marine Fisheries Service, Army Corps of Engineers, FERC)	In-flow projections; Scenario planning and trainings; Post-event analysis	(✓)	✓	✓	(✓)
	Sub-national organizations (e.g., river basin commissions, Association of State Floodplain Managers, Biologic Opinion)		(✓)	✓	✓	
	Community organizations (e.g., Tanana Chiefs, Alaska Federation of Natives)		(✓)	✓	✓	
	International organizations (e.g., Rio Grande Compact, IBWC, IJC[1])		(✓)	✓	✓	(✓)
Recreation	National orgs (e.g., Parks Service); Boating organizations (e.g., American Whitewater, Colorado River Boatman's)	Inundation maps[2]; Flow analysis	✓	✓		
Agriculture	National organizations (e.g., USDA, NRCS)	Long-term flow projections; Land analysis (e.g., soil moisture)	✓	✓	(✓)	(✓)
Ecosystem management	National partners (e.g, NMFS, FWS, NOS, NORR)	Water quality (e.g., nutrients, temperature, dissolved oxygen); In-stream flows; Monitoring (not just projections)	✓	✓	✓	(✓)
	Water authorities		✓	✓	✓	(✓)

1 International Boundary and Water Commission (IBWC), International Joint Commission (IJC); 2 Inundation mapping includes time of flood and peak flood, duration, confidence, and worst case

Exhibit 50: Idea for water services collaborative forecast process



Re-evaluate reporting alignment for RFCs

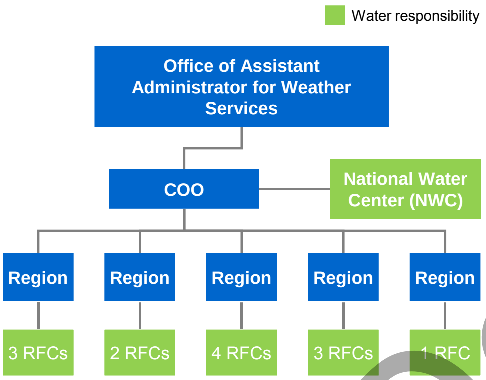
The OWA team and water services subject matter experts also considered the reporting structure of RFCs: either to maintain status quo alignment of RFCs under regional HQs or an alternative, of reporting to the Office of Water Prediction's National Water Center (NWC), which could align all water services field offices under one chain of command.

Exhibit 51: Ideas for reporting structure of RFCs

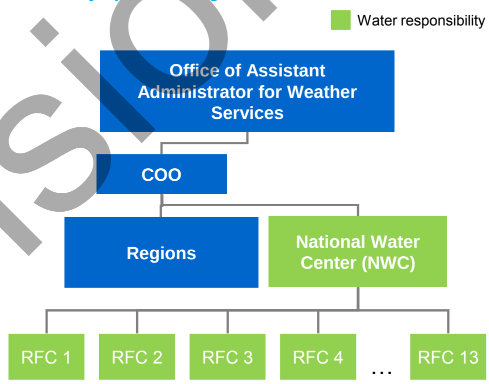
Goal: Create alignment for RFCs to increase consistency and enhance provision of IDSS

Ideas	Pros	Cons
(A) Keep status quo, where RFCs answer to regional HQ	▪ Acknowledges strength of “status quo” - RFCs currently act relatively independently to provide specialized IDSS to their stakeholders ▪ Maintains relationship between WFOs and RFCs; both answer to RDs and can easily share information through region	▪ Does not improve alignment within the water program ▪ Does not address resource or management attention challenges
OR		
(B) Align RFCs under the National Water Center	▪ Facilitates water program alignment throughout field structure ▪ Supports RFCs with NWC resources ▪ Develops a national voice for water ▪ Allows for sharing of best practices	▪ Could potentially de-prioritize WFOs as a partner for RFCs and increase silos ▪ Could hinder coordination between WFOs and RFCs during high impact events

Status quo option for organization structure



Secondary option for organization structure



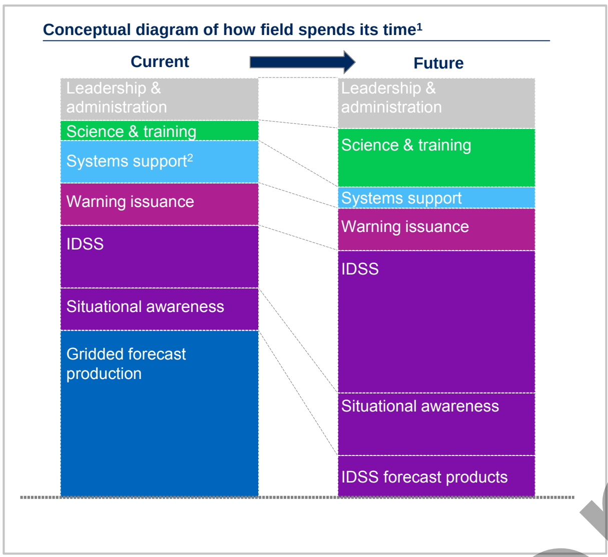
Additional considerations

- Vision and mission of NWC and resources and abilities aligned to NWC are critical decisions that should be aligned with needs of RFCs and field
- Could additionally require alignment between NSPs and NWC to help align RFC to all water resources in NWS
- Would need to clarify reporting lines of Service Hydrologist
- If status-quo is chosen, current variance in hydro programs between regions and lack of communication between RFCs and their regions would need to be addressed

Unlock time for strategic staffing through function and form changes at WFOs

Given the vision for deep relationships IDSS, a collaborative forecast process, and a fully integrated field structure, WFOs could shift the allocation of time on certain functions. Exhibit 52 shows the idea that WFOs could shift time from gridded forecast production to IDSS, and to increased focus on science and training to enable the science-based service operating model.

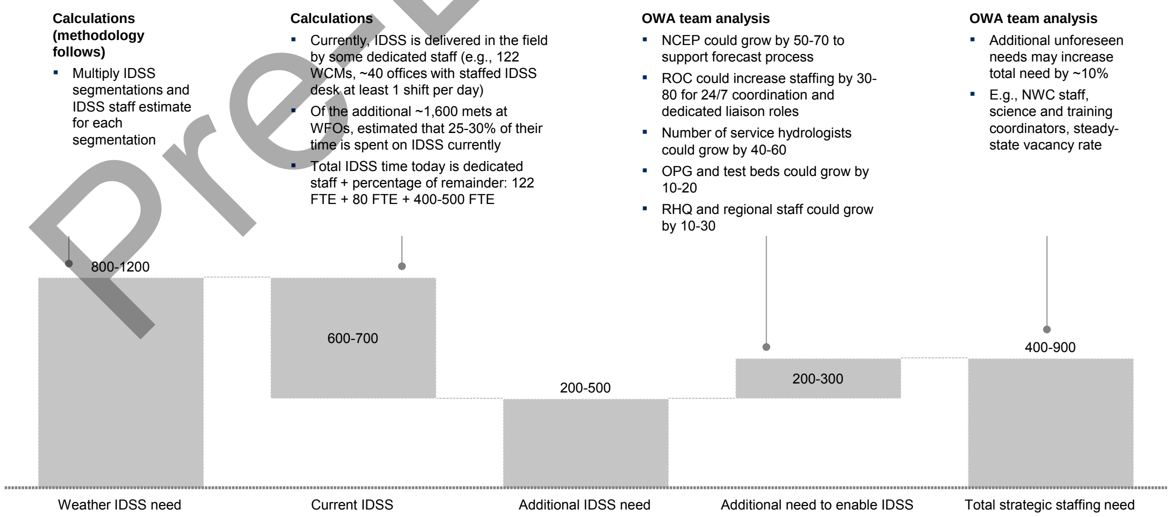
Exhibit 52: From-to on WFO allocation of time



1 Based on best data available including standard role mix, position descriptions, and interviews; testing and evaluation in FY17 will quantify time saved; could vary across WFOs; 2 Includes dissemination, AWIPS, QA/QC data, observations network maintenance

The OWA Field Director team further investigated the IDSS demand across the country in order to develop ideas for how best to shift time in WFOs and how to align staff to demand. The OWA project teams and OWC developed a methodology for evaluating the level of IDSS demand and estimating the staffing levels required to fill that demand (detailed in the Workforce Ideas section and in the Appendix). The analysis also considered what additional investment in other offices (e.g., NCEP, ROCs, OPG, RHQ) could be required to support the deep relationships IDSS and collaborative forecast process operating model envisioned. Analysis of the idea suggests that there could be 2x the demand for IDSS than is being served today, and that 200-300 additional FTE may be needed to enable the operating model.

Exhibit 53: Flexibility needed to support science-based service operating model



In order to meet the strategic staffing need, the OWA project teams and the OWC identified seven functional and form changes that can unlock time currently spent on lower value activities in WFOs than the envisioned new science-based service operating model. In order to increase time for IDSS and to allow for more agility in the field structure so that new demands can be met as they arise, NWS could pursue the following "unlocks" of WFO staff time.

Exhibit 54: "Unlocks" idea to increase flexibility in WFOs

Seven functional and form "unlocks" can provide significant flexibility for NWS field offices

1	STRATEGIC STAFFING	NWS will move away from "one-size-fits-all" staffing, allowing staff to be distributed to meet partners where they are	Addresses need to align staff to workload
2	COLLABORATIVE FORECAST PROCESS	Field offices use a common operating picture to ensure consistency and create a more efficient process that frees up valuable, needed staff time	Address internal processes and role assignments that limit time needed for IDSS
3	GS5-12 CAREER PROGRESSION	Updated career progression for mets increases time spent by GS 5-11 meteorologists on high value activities contributing to IDSS	
4	AUTOLAUNCHERS	Automated launches free up staff at upper air sites and allow for flexibility in scheduling shifts	
5	SHIFT SCHEDULING FLEXIBILITY	Office operating hours are set strategically to address partner needs, so not all offices devote resources to staying open 24/7. Requires offices to collaborate through mutual aid for met watch during off hours, while sustaining situational awareness and surge capacity	
6	STAFFING LEVEL FLEXIBILITY	Offices set staffing levels to best serve partners, without requiring each shift to have two staff members	Address form constraints that limit flexibility needed – if unable to be unlocked, 40% of IDSS needs will remain unmet
7	STRATEGIC POSITIONING	Offices and roles are located to best serve partners and meet internal NWS needs (e.g., IDSS staff near partners, maintenance staff near strategic needs)	

Each of the "unlocks" provide flexibility that can be redeployed on higher value activities so that NWS can take full advantage of its field force. The collaborative forecast process and the met watch backup function are the most critical functional changes, and releasing one of the 24/7 requirement or the 2 per shift requirement is a critical form change. Exhibit 55 shows how the functional changes build up flexibility in the workforce, and how the form changes, if not achieved, could reduce that flexibility.

Exhibit 55: Unlocks of WFO staff time

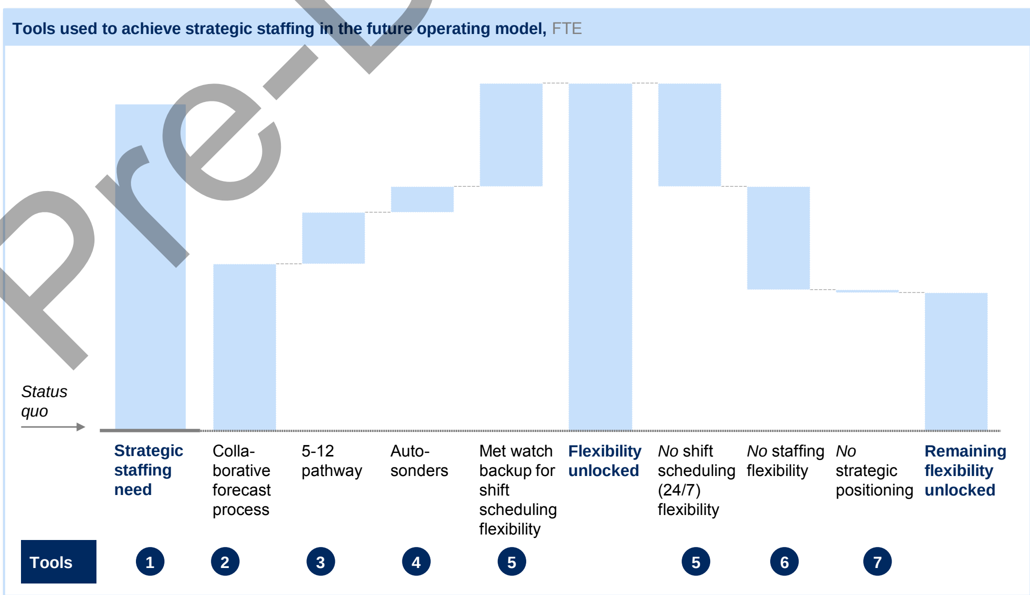
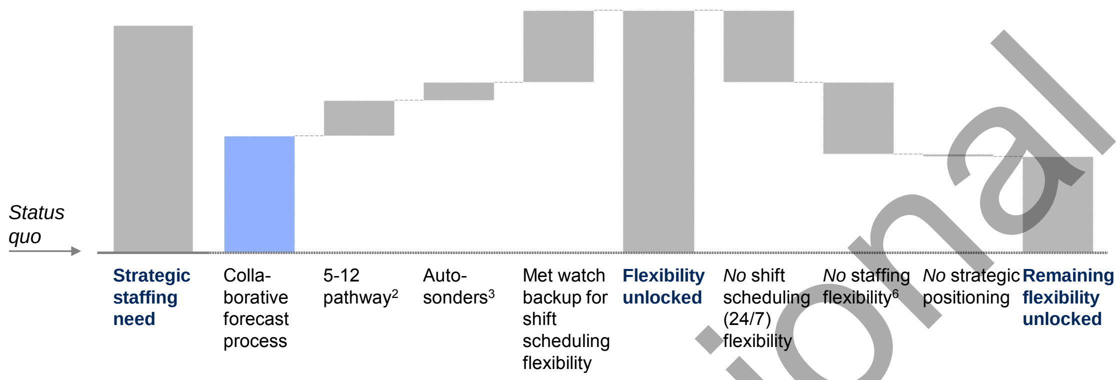


Exhibit 56: Collaborative forecast process "unlock"

Focus of slide | Dependencies on other unlocks

Calculations
- Estimate of ~2 shifts per day at each WFO currently devoted to grids[1]
- Collaborative forecast process frees up all of that time
- Estimated unlock is 4 FTEs at each WFO, ~400-500 total

Considerations
- Even if equivalent of two full shifts per day aren't spent on grids, meteorologists still tied to their desks to meet production deadlines and produce other forecast products



1 Estimated through interviews, site visits, and results of MIC Survey in April 2016 showing 60% of offices have separate short-term and long-term forecast desks, with majority of offices staffing 6-8 shifts per day; met time spent generating forecast estimated at ~25-30% of shift

Exhibit 57: 5-12 pathway "unlock"

Focus of slide | Dependencies on other unlocks

Calculations
- Of the total 180 GS-11s, assume 50% become GS-12s and their time is fully unlocked (90 FTEs)
- Of the remaining 200 interns (GS-5-9 and remaining GS-11s) assume 30% of their time can be unlocked due to shift in PSU functions (60 FTEs)
- Total unlock is equivalent to ~150 FTEs

Considerations
- Assumes time of the fully unlocked GS-11s is currently not spent on "unlocked" functions
- Assumes further GS-5-9 time cannot be unlocked due to training needs

Dependencies
- Assumes that this unlock does not double-count with time spent currently launching balloons

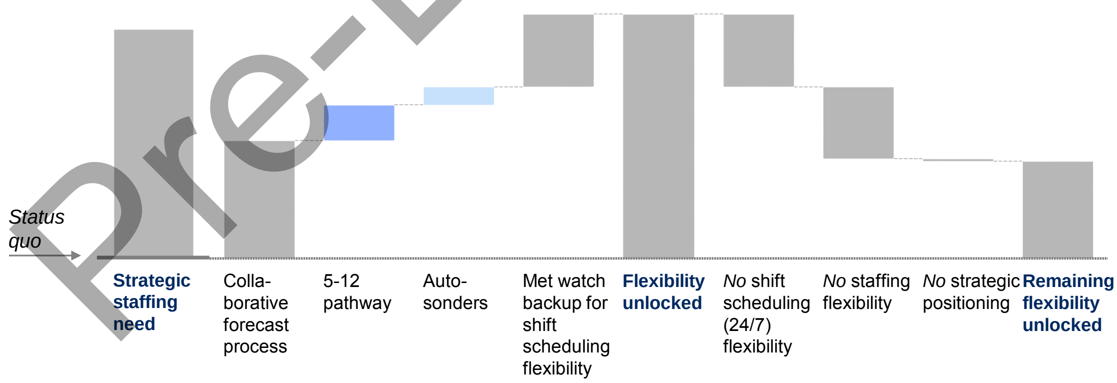


Exhibit 58: Autolaunchers "unlock"

Focus of slide   Dependencies on other unlocks

Calculations

- At 12 Alaska WSOs, assume the full unlock of 3 FTE currently at those locations (36 FTE)
- At ~80 CONUS sites, assume that 1-2 hr/day is freed up by not launching balloons, for total of 500-1000 hrs per week. (~15-30 FTE at 40 hrs/week)
- Total unlock is ~50-70 FTEs

Considerations

- May be further financial "unlock" if CONUS locations with contracted staff are converted to autosonders

Dependencies

- At Pacific region locations, balloons currently launched at 1am. Not installing autosonders may eliminate any benefit of reducing to below 24/7 via other unlocks because someone would need to launch the balloon

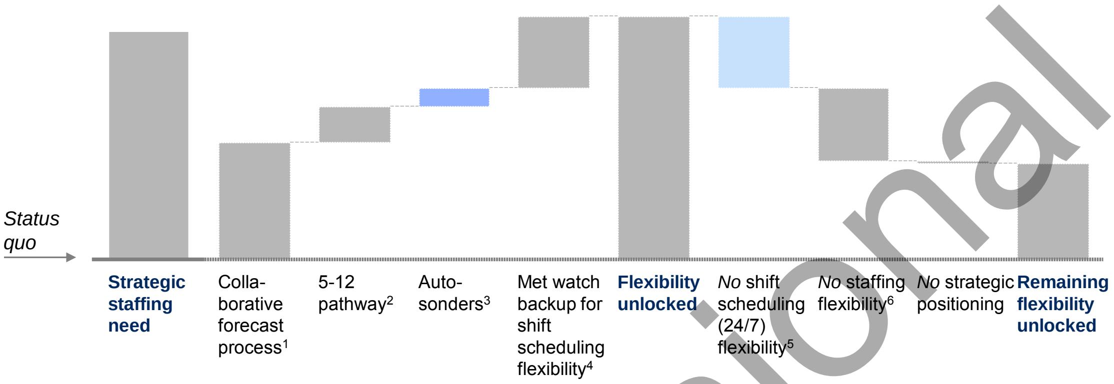


Exhibit 59: Met watch backup "unlock"

Focus of slide   Dependencies on other unlocks

Calculations

- At offices categorized as "low" IDSS demand, there may be very limited regular IDSS demand outside of normal business hours. Having a warning backup removes requirement to have a person on-shift the other two shifts per day (4 FTE per office at 25 offices)
- At medium IDSS offices, assume there is very limited IDSS demand on one shift per day (may be swing or mid shift). At each low office, having a warning backup removes requirement to have a person on that shift (2 FTE per office at 37 offices)
- Total unlock is ~150-200 FTE

Considerations

- Does not include any savings from times where offices "spin-up" to provide additional met watch, which could be provided by back-up office without spinning up

Dependencies

- Benefits from being able to switch to a back-up to cover is undone if all offices required to be 24/7 anyway

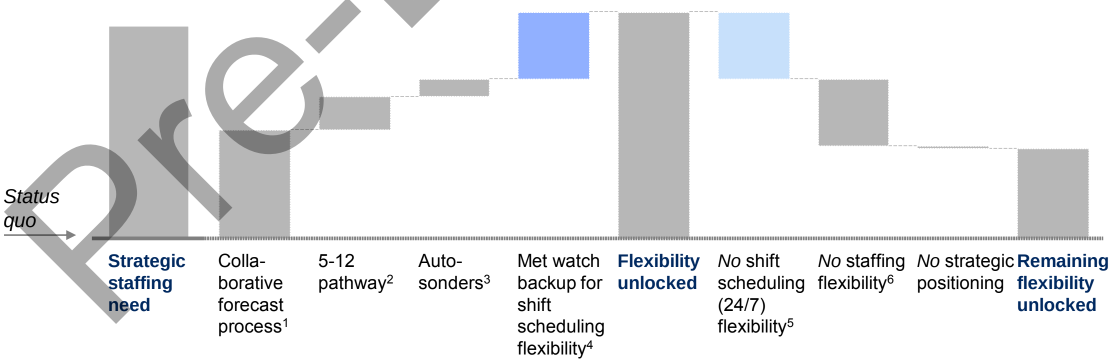


Exhibit 60: Shift scheduling flexibility "unlock"

Focus of slide | Dependencies on other unlocks

Calculations

- Equal to met watch backup unlock because with collaborative forecast process, 5-12 pathway, autosonders, and met watch backup, there are limited further requirements to "unlock" to enable a change in operating hours in offices without 24/7 IDSS demands
- Loss of this unlock would require staffing individuals on shifts for which there are no remaining functional responsibilities in the future paradigm, so would represent a loss of flexibility that could have been used for IDSS or other need

Considerations

- Does not include any savings from times where offices "spin-up" to provide additional met watch, which could be provided by back-up office without spinning up

Dependencies

- Dependent on functional unlocks described

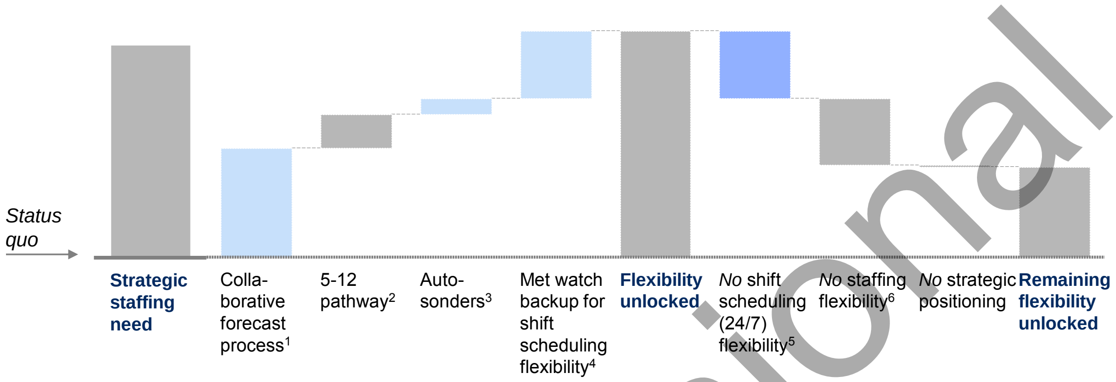


Exhibit 61: Shift staffing "unlock"

Focus of slide | Dependencies on other unlocks

Calculations

- Medium offices add 1-2 people to mid shift where only person would have been on met watch or met watch may not have been needed (2-4 FTE per office at 47 offices)
- Low offices add 1-2 people each to otherwise unstaffed swing and mid shifts, or shifts staffed with 1 person for met watch (4-8 FTE per office at 25 offices)
- Total unlock estimated at ~200-300 FTEs

Dependencies

- Depends significantly on how the met watch function is conducted, and if offices are allowed to not be 24/7
- Would vary based on how the IDSS operations are scheduled in an office as well. For example, if low office was allowed to close but scheduled single IDSS staff on two shifts per day, requirement of two/shift would require two additional staff per day (4 FTE) across those two shifts. If two staff on single shift and met watch backup allowed, then two/shift would have no effect. Difference here is 100 FTE, considering only the low segment.

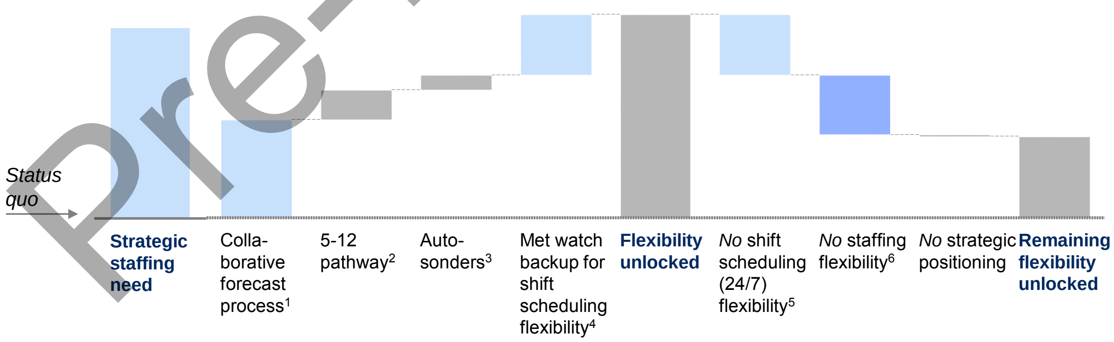
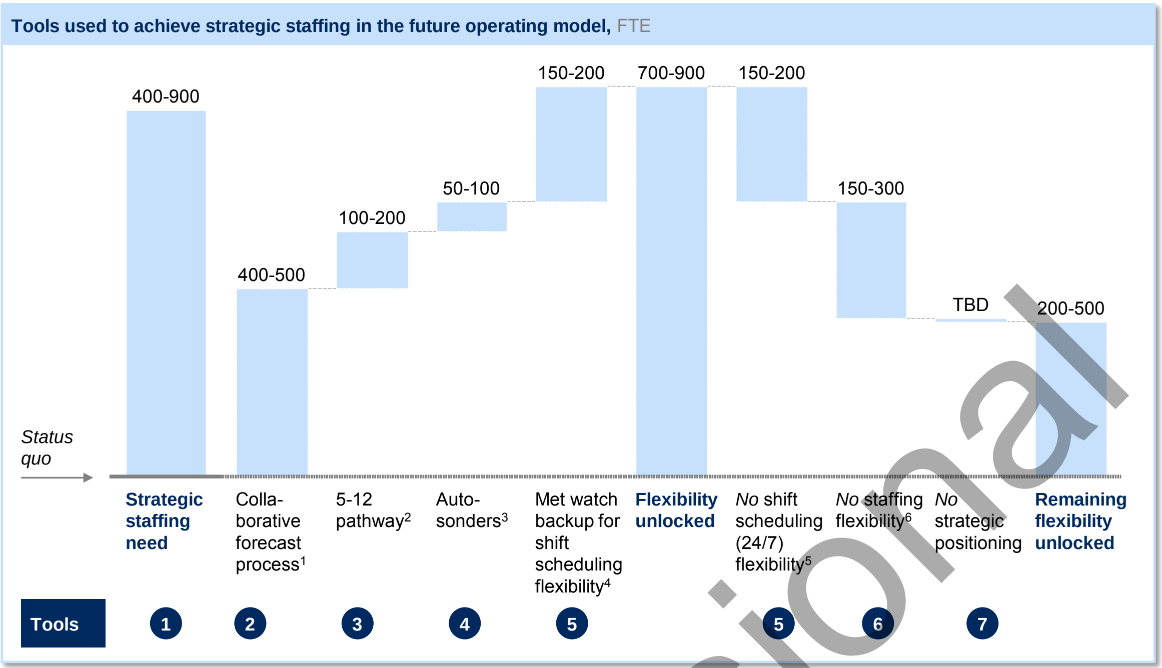


Exhibit 62: Total unlock of WFO staff time



As flexibility is achieved, staff can be redeployed to focus on IDSS functions, or to work more daytime hours when partners need them, or even to move across offices given varying levels of IDSS demand across the country (see Idea for a Fully Integrated Field Structure).

Establish formal mechanisms for offices to support each other

The findings showed that there are some functions that are not effectively or efficiently performed within each WFO. As staffing becomes more asymmetric in the future model, there could be an increased need for offices to support each other – offices that are smaller may occasionally need surge support. WFOs could support each other in ensuring all offices can surge when needed and have "hot backup" from other offices.

In particular the OWA teams saw a need to provide additional met watch coverage, or "hot backup", given the increasing need to manage large volumes of data to maintain situational awareness and develop up-to-the-minute environmental intelligence for partners. Additionally, as some offices become smaller to match IDSS demand, it may be difficult for those offices to sustain operations if there is a prolonged event – they could need more backup than the current organizational structure provides. And even in the current state, the OWA findings show that at current resource levels (and with vacancies) it is difficult for an office to sustain 24/7 met watch operations and serve IDSS partners.

There are several ideas for how to provide met watch capacity to all CWAs – all offices could operate a designated met watch shift 24/7, all offices could operate met watch during operating hours with backup when closed, or a set of offices across the country could provide met watch on behalf of broader areas that encompass multiple CWAs.

Exhibit 63: Scenarios for providing met watch

Met watch scenario	Description
24/7 met watch at all offices	▪ All offices have dedicated shift for met watch 24/7, to focus on situational awareness and environmental intelligence ▪ Offices could be designated as "hot backup" sites for each other ▪ Increases the minimum size of a given office, as additional staff are needed beyond staff for IDSS
Met watch handover	▪ High and extreme IDSS offices have dedicated met watch shift 24/7, which provides "hot backup" to neighboring CWAs during their operating hours and full met watch coverage when neighboring offices are closed ▪ Medium offices have two met watch shifts per day, and low offices have one met watch shift per day, increasing minimum size of an office ▪ Offices collaborate during events to ensure all offices have sufficient coverage for met watch, warning production, and IDSS
Area met watch	▪ Dedicated met watch shift staffed 24/7 at ~40 offices, provides full time met watch coverage for multiple CWAs as appropriate given size and frequency of events ▪ Offices collaborate during events to ensure all staff have situational awareness required to provide IDSS

In all cases, staff operating met watch shifts and staff operating IDSS shifts would have to be in close collaboration. In some cases, warnings could be issued by the met watch office and communicated by the WFO with the IDSS relationships. In these cases, close coordination and maintaining enough situational awareness at the local level to convey it confidently to partners is paramount. The OWA team envisioned a potential model that could allow offices to provide met watch and potentially some warning issuance in support of other offices.

Exhibit 64: Conceptual diagram of IDSS and met watch staff interaction to serve partners

	Possibility of a weather or water event forecast	Weather or water event begins to look very likely	Potential for a dangerous event escalates	Event is occurring	→ Partner decision-making
IDSS staff	▪ Share forecast information and analysis relevant to the partner	▪ Discuss forecast with NCEP and other offices affected to determine if watch/outlook needed ▪ Discuss potential scenarios and impacts with partners ▪ Arrange overnight staff coverage	▪ IDSS staff share increasing potential for a dangerous event with partners, and aid in scenario planning as needed ▪ IDSS staff deploy if needed	▪ IDSS staff determine what to communicate to partners about the impacts of the event, share through best channel for that partner, and provide live support as needed throughout the event	
Met watch staff	▪ Monitor forecasts and observations to remain situationally aware	▪ Monitor forecasts and observations to remain situationally aware ▪ Make recommendations to adjust staffing as needed	▪ Collaborate with IDSS staff on warnings ▪ Remain in constant communication with offices whose partners may be affected	▪ Continue to monitor the event and release updates	

These ideas for met watch have different resource implications to consider given that resources that are committed to dedicated met watch shifts cannot be used flexibly for IDSS needs.

Exhibit 65: Resource usage in met watch scenarios

Met watch scenario	Mets needed for met watch	Mets available[1]	% of IDSS operating model needs filled[2]
24/7 met watch at all offices	950	750	60%
24/7 met watch at all offices with 1/shift at times	750	950	75%
Met watch handover	550	1150	90%
Area met watch	250	1450	110%

1 Based on 1700 total operational field meteorologists available, including forecasters and WCMs
2 Mets available divided by mets needed (~1000, midpoint of IDSS demand plus ~250 midpoint of additional need at NCEP, ROC, etc, rounded)

The OWA project also considered ideas for offices to share dedicated training coordinators who could supplement current training activities in the field, dedicated research coordinators who likewise could supplement management of university partnerships and research projects across offices, and area IDSS managers who could focus on state and other cross-CWA relationships. The OWA project also considered how managers of large offices could provide resource support to smaller offices as needed.

Develop additional supervisory positions

To address the finding on span of control being too high in WFOs, the OWA project considered giving some SOOs and WCMs supervisory responsibilities, although as offices become more asymmetric the need for such roles could change (at some offices increasing and perhaps warranting dedicated positions, and at others the need shrinking). Currently, MICs have a span of control of 1 to 22 and often have no supervisory experience prior to entering the position – described by one MIC as, "ready, set, fail." WCMs and SOOs are already part of the management team, but they have no formal supervisory authority. Providing them with this responsibility could allow for supervisory experience earlier in an employee's career, reduce the span of control in a WFO to 1 to 7, and allow for closer supervisor / supervisee relationships.

To address the RD span of control, the OWA project considered organizing offices into group ("area", "cohort", or "cluster") configurations, with MICs either reporting to one MIC in the group, or to a group manager who could be embedded into one of the offices (in the same way as a Navy ship carrying a fleet Admiral nonetheless retains its own Captain and internal command structure while the Admiral manages the activity of the fleet).

Focus on priority practices such as role clarity, capturing external ideas (innovation), and creating an open and trusting environment

Many of the ideas on roles and responsibilities could increase role clarity across field offices. Ideas for dedicated research coordinators and for offices to support each other more closely could improve NWS's ability to capture external ideas and incorporate them into operations. The OWA teams have developed ideas such as the Field Communications Network to help create a more open and trusting environment, and the OWA project itself has sought to operate in a transparent manner and to involve internal and external stakeholders early and often.

IDEA FOR A FULLY INTEGRATED FIELD STRUCTURE

The findings on workforce, operating model, and organizational structure indicate that the current distribution of staff across the country can evolve to better serve partner needs	■ Apply the strategic staffing blueprint given ideas on roles and responsibilities to re-align staff to match workload

The OWA diagnostic findings, paired with the vision for the future and ideas for evolving the NWS, indicate that the current distribution of staff across the country could evolve to better serve partner needs.

The fully integrated field structure refers to the location and size of NWS field offices, and is supported by the workforce model (i.e., how NWS develops and deploys staff), operating model (i.e., how staff work together to deliver products and services), and organizational structure (i.e., roles and responsibilities at each office).

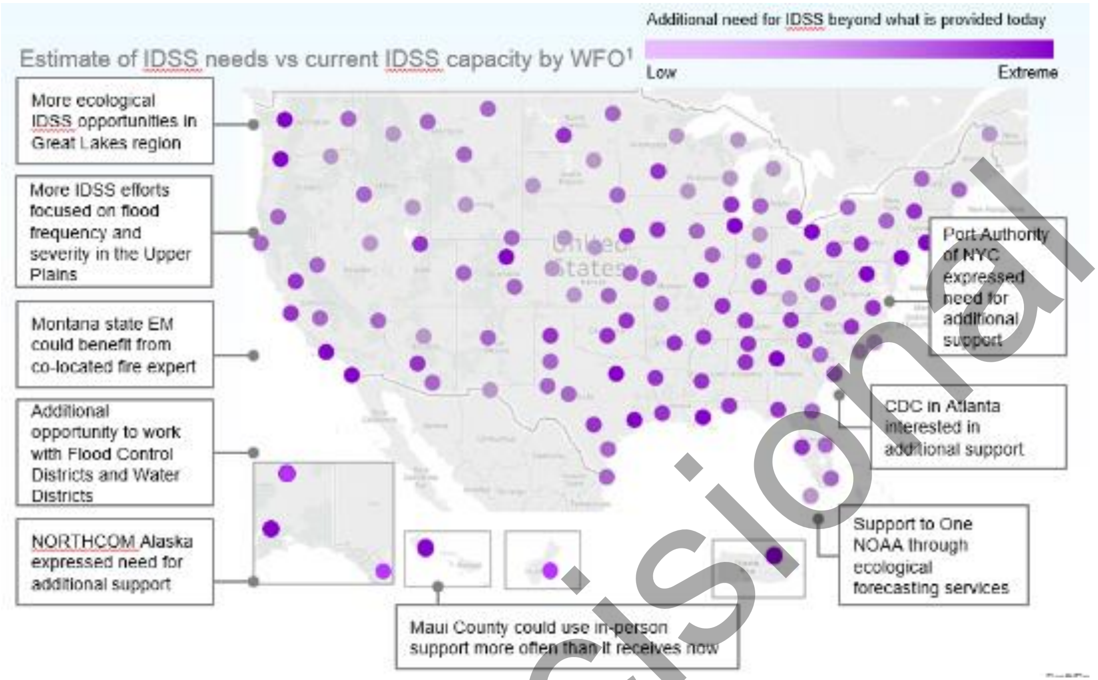
Apply the strategic staffing blueprint given ideas on roles and responsibilities to re-align staff to match workload

The OWA Fully Integrated Field Structure team developed initial ideas on how to estimate IDSS demand across offices using several dimensions and how to staff to meet that demand. The dimensions included 1) people and property, 2) weather types, 3) weather frequency, 4) vulnerability, and 5) presence of core and deep partners. The dimensions seek to balance quantitative indicators of demand, such as population, GDP, and hazard information, with qualitative factors, such as unique aspects of the population or geography or how decisions are made for that area. A similar methodology was used to separately estimate water services IDSS demand. See Appendix for detailed methodology.

The Field Director team tested the idea by using an iterative approach to evaluate each office's area of responsibility according to these dimensions and segmenting offices as having low, medium, high, or extreme IDSS demand. The Field Directors also refined the potential operating models for offices in each segment of IDSS demand, with extreme offices having the highest staffing and 24/7/365 operations, contrasted with low offices having less staffing and business hour operations (see

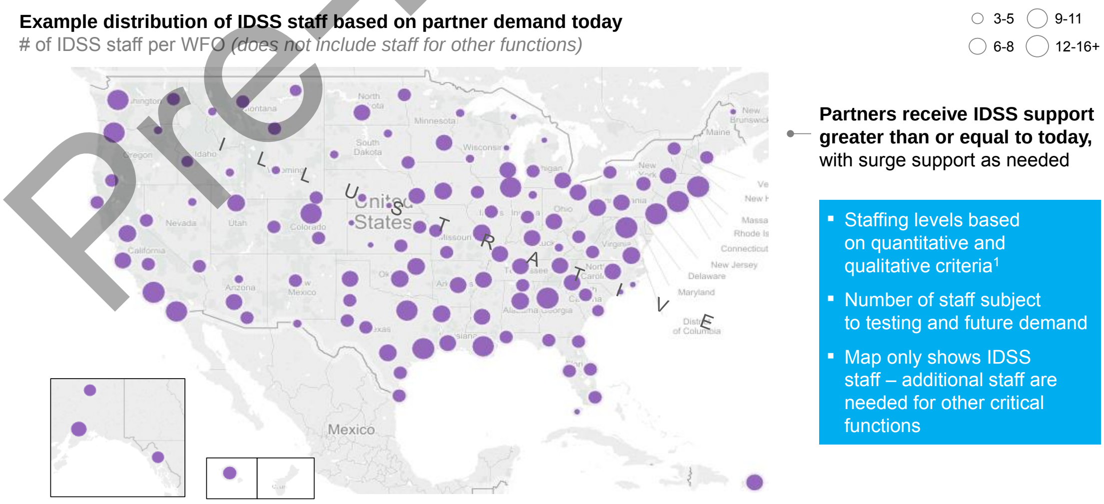
Appendix for detail). A potential future staffing level for each office was then produced using the segmentation and estimated IDSS staffing levels. Exhibit 66 shows where additional need for IDSS may be distributed across the field structure.

Exhibit 66: Estimated WFO capacity for meeting IDSS demand



According to this staffing methodology, IDSS staff could be distributed at different levels across the country, ranging from 3-5 meteorologists in the lowest IDSS demand locations to 14+ staff in the most extreme IDSS demand locations. Importantly, these staff numbers are only for the IDSS function; additional staff are required for other office functions.

Exhibit 67: Potential distribution of weather and water IDSS staff at WFOs



1 Staffing levels based on population (resident and seasonal; absolute and density), GDP, types of weather affecting the area, frequency of weather affecting the area, vulnerability of the population to weather, and presence of core and deep partners; criteria include water drivers (e.g., drought, dams)

Applying the next layer of the blueprint, staff for the met watch function, could add staff to some or all of the offices to operate a dedicated met watch shift. There are multiple scenarios for how to allocate staff for met watch (see Ideas on Organizational Structure, Exhibit 63). Exhibit 68 shows one potential allocation of met watch staff, if larger WFOs provide met watch for other WFOs in their area.

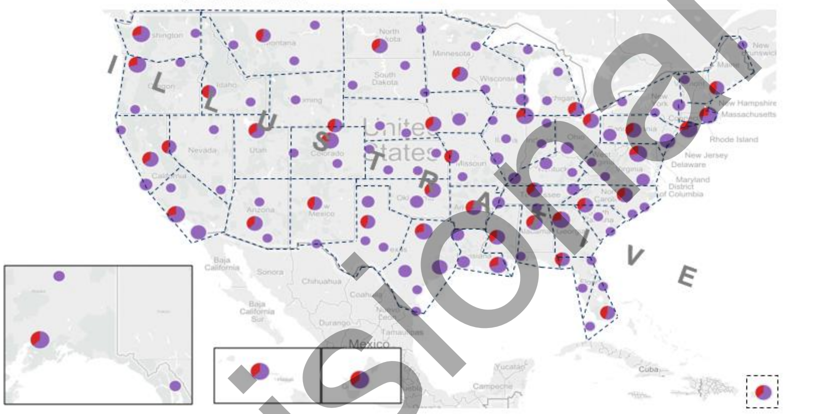
Exhibit 68: Potential staffing outcome with IDSS and met watch staff

- **Additional met watch support would be provided across offices[1]**, from staff operating dedicated met watch shifts
- **This concept requires significant testing and evaluation:**
  - **Science-based tests** to ensure no degradation of lead time or accuracy
  - **Service-based tests** to ensure partners receive high quality information

Example alignment of IDSS and met watch staff based on workload for all warning types and IDSS

Office size range by location

Office grouping[2] | IDSS | Met watch | 3-5 | 6-8 | 15-17 | 18-22+



1 Location of additional met watch support determined based on alignment with high/extreme IDSS missions, offices with a frequent 24/7 mission, and ability to achieve sufficient volume of warning activity; 2 Office groupings determined based on similar climatological and partner needs. Grouped offices collaborate extensively to provide best services to partners (e.g., coordinating IDSS, providing surge resources). Groupings balance workload (e.g., volume of warnings)

On top of the IDSS and met watch staffing allocations, support staff (for science and training, systems support, and leadership and admin) are then allocated per the strategic staffing blueprint. Exhibit 69 provides an illustrative view of what staffing could look like given IDSS workload estimates, one of the met watch scenarios, and support staff aligned strategically given office size and economies of scale for groups of offices.

Exhibit 69: Potential strategic staffing outcome

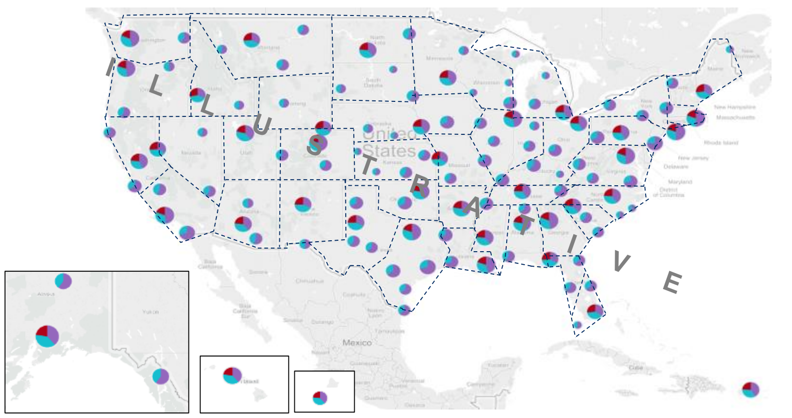
All core and deep partners receive increased support through:

- **IDSS from local experts** when and where needed
- **Focused, experienced warning experts** in their area
- **High quality forecasts** informed by expertise at all offices, including NCEP and NWC, based on a common operating picture

Example alignment of workforce to today's workload

Office size range by WFO[1]

IDSS[2] | Met watch | Support[3] | <10 | 10-19 | 20-29 | 30+



1 There are offices of all sizes within these ranges, and offices could include embedded / "satellite" staff; 2 Includes staff time spent on collaboration on the forecast, creation of specific forecast products (e.g., spot forecasts); 3 Includes staff for systems development & support, science & training, and leadership & administration

The OWA team also used a workforce planning model to test the overall labor cost and hiring needs implications of any change to the field structure. The model uses financial data from the Office of the Chief Financial Officer, including average cost by position and location, and estimates costs within 3% of total current NWS labor costs. The model also includes assumptions for vacancy rates. There are many scenarios in which NWS could staff the fully integrated field structure within current labor resource levels and staffing numbers, although flexibility to do so is contingent on the unlock ideas described. The workforce planning model was also used to assess how long it could take NWS to transition to a fully integrated field structure given attrition rates and voluntary move assumptions. Depending on the scenario input, the model suggests that NWS could transition to a fully integrated field structure within 5 years given some use of VERA/VSIP or within 10 years without, but that the speed of hiring actions could delay the transition over any interval.

In applying the blueprint, offices could take on many shapes and sizes based on the particular demands in the area and how they play a role in supporting other field offices. The blueprint could be applied regularly to reassess if staffing levels match workload – as new capabilities become available, as partner needs shift, and as NWS partners further with other NOAA line offices, staffing needs could change. With the flexibility provided by the workforce, operating model, and organizational structure ideas, NWS could continually adapt its fully integrated field structure.

Moving towards the vision through test, evaluate, involve

NWS has considered the findings and ideas of the OWA project, and is prioritizing testing and evaluation of many of the workforce, operating model, and organizational structure ideas, as well as the idea for a fully integrated field structure. Some of the ideas can be tested, evaluated, and acted upon sooner than others – some ideas are already being tested and evaluated, while others will be over time.

NWS has already taken action towards testing and evaluating the workforce and operating model ideas through normal governance processes. For instance, OWA has led testing of IDSS partner definitions and core service levels through a field exercise and through a Public Notification Statement on the policy. Through these efforts, gray areas in need of further guidance have been refined and will be resolved. NWS is also building on the vision of a collaborative forecast process by designing tests to leverage the National Blend of Models as a single starting point for forecasts – two tests are already planned for Fiscal Year 17. OWA has also led further design and testing of a GS 5-12 career progression by building out a detailed competency model and developing plans to test the model through tabletop performance and promotion conversations. NWS has also developed the NWS 101 onboarding program, which it will refine as the first class attends.

NWS will test and evaluate the "7 unlocks" that provide staff additional flexibility to meet demands of the science-based service operating model, with much of the testing to occur in Fiscal Years 17 and 18. Given the magnitude of change required for some of the unlock ideas, NWS expects the vision will be achieved in phases. In the first phase, opportunities that could be acted on currently or in the very near-term will be prioritized; these include identifying where there is not sufficient workload to require current staffing levels, establishing a common starting point and reducing requirements for WFOs to edit long-term grids, and installing autolaunchers. In the second phase, additional strategic staffing could be achieved through further reductions in grid editing, the establishment of backup protocols so that some offices could reduce operating hours, and full use of autolaunchers. Finally, in phase three, grid editing workload could be eliminated from WFOs, and pending testing and evaluation, "hot backup" could reduce the need for dedicated met watch in all offices, on all shifts.

Exhibit 70: Phased approach to acting on OWA ideas

	Phase 1: Increasing flexibility	Phase 2: Evolving form and function	Phase 3: Realizing the vision
Description	▪ Some strategic staffing via changes to requirements on staffing and in the forecast process	▪ Additional strategic staffing via changes to operating hours and improvements in forecast process	▪ Further flexibility via tailored locations and a fully implemented collaborative forecast process
"Unlocks" used	▪ **Some strategic staffing**, with additional positions added at offices with highest IDSS gap today ▪ **Collaborative forecast process** enables WFOs to limit grid production to high impact edits ▪ **5-12 pathway** generates additional forecasters at the GS12 level available for shifts ▪ **Shift staffing flexibility** increases mets available on day-time shifts ▪ **Autolaunchers** provide forecasters some additional time for IDSS	▪ **Additional strategic staffing** as flexibility is unlocked and new capabilities proven ▪ **Collaborative forecast process** further enables WFOs to reduce time spent on routine grid production ▪ **Shift scheduling flexibility** gives offices option to match partner hours, with backup provided by office in area ▪ Full use of **autolaunchers** ▪ **Some strategic positioning** of staff allows more in-person service	▪ **Full strategic staffing**, as flexibility is unlocked and new capabilities proven ▪ **Collaborative forecast process** and further technology improvements allow WFOs to focus only on forecast products as needed for IDSS (e.g., spot forecasts) ▪ **Focused, expert met watch shifts** provide service to offices and partners in an area ▪ **Strategic positioning** of staff allows more in-person service
% of IDSS flexibility met [1]	~50%	~75%	~100%

NWS anticipates further investigating the following questions through an inclusive process of testing and evaluation:

- How will NWS determine how much capacity is needed to provide IDSS across the country? Further analysis and testing needed:
  - Testing and refining methodology for determining IDSS demand
  - Studying staff capacity needed to serve core and deep partners around the country, at IDSS philosophy service levels
- How will NWS "unlock" staff time to focus on IDSS or to move to an office where there is additional demand for IDSS? Further analysis and testing needed:
  - OPG tests, field tests (i.e., executed through hot backup), and live demonstrations or pilots to test changes to processes and roles and responsibilities
  - Time studies and service assessments to determine if the unlock is achieved and if the resulting process is high quality
- How will NWS ensure the quality of the forecast and warning products, as well as services, are maintained? Further analysis and testing needed:

- Test and evaluate changes to its operating model and organizational structure before implementing them
- Evaluation will include product quality metrics, service metrics, and efficiency metrics – and tests will include partners when appropriate

NWS has begun planning for significant test and evaluate activities, to involve internal and external stakeholders. Each Region has committed to championing one of the tests and participating in one or more of them.

NWS recognizes that addressing the findings of the OWA project and acting on the ideas is a substantial undertaking, and one that is critical to evolving the NWS to deliver a Weather-Ready Nation. Through the OWA project, NWS has built alignment among senior leaders on the vision, and commitment throughout the organization to act on many of these ideas. NWS will continue to bring internal and external stakeholders into the process of testing and evaluation, and will refine these ideas for how to achieve the information throughout each future phase of the work.

The benefits for the nation and for NWS staff

These ideas have been designed to enable a science-based service operating model and move the National Weather Service towards a more "customer-centric" organization. The OWA diagnostic found that partners value the local presence and interpretive services that make it easier for them to protect lives and property. The diagnostic also found that staff feel the current field structure constrains their ability to serve their partners and to stay motivated. By working together with internal and external stakeholders the NWS can refine this vision and enact it to build a Weather-Ready Nation.

- The field structure described could **improve protection of life and property** by:
  - Providing more staff on day-time shifts to support preparation, mitigation, and recovery when their partners are spending time on these activities
  - Deepening the operational support available during events
  - Developing and leveraging experts across field offices
  - Coordinating forecasts and messages across offices
  - Making NWS more agile and nimble to respond to changing demands
- The field structure described could also **improve NWS organizational health** by:
  - Limiting harmful overnight shift work and creating a desirable workplace for a diverse range of employees
  - Enabling staff to spend more time on high-impact meteorology and hydrology
  - Making time for staff to spend more time on what they describe as most rewarding: helping others and protecting lives and property

– Creating additional career pathways through specialist roles and management positions at different levels

Appendix

SITE VISIT METHODOLOGY

Exhibit 71: Sites visited in diagnostic phase

Selection approach

- First, a list of all NWS locations was generated including data on the following criteria:
  - Office type (WFOs, RFCs, Regional HQs, CWSUs, TWCs)
  - Marine vs. land-based coverage
  - Population density
- Second, locations were randomized to be representative across the above criteria to ensure:
  - At least 2 visits per region in continental US
  - 1 visit per region in Pacific/Alaska
- Then, a national perspective was taken to consider:
  - NCEP locations
  - Other factors (e.g., type of weather events like fire weather, IDSS needs)

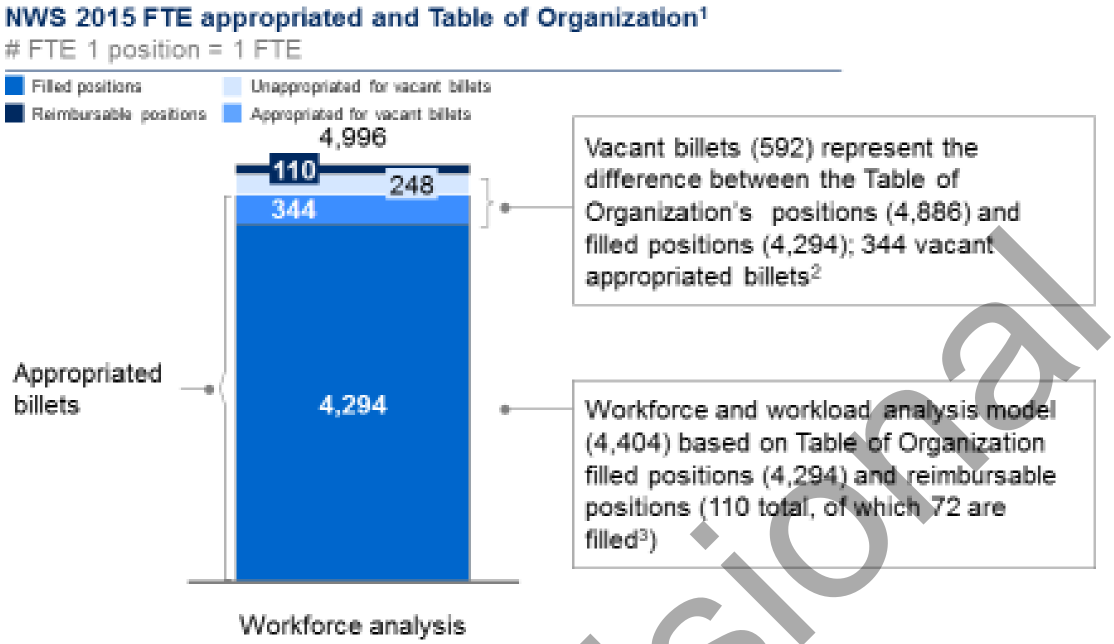
Site visit list

- Eastern
  - Taunton, MA (WFO, NERFC)
  - Cleveland, OH (WFO)
  - Charleston, SC (WFO)
- Southern
  - Ft Worth, TX (WFO, CWSU, WGRFC, RHQ)
  - Key West, FL (WFO)
  - Miami, FL (WFO, CWSU)
  - Norman, OK (WFO)
- Pacific
  - Honolulu & Hilo, HI (WFO, RHQ, ITIC, PTWC, DCO, CPHC)
- Central
  - Grand Forks, ND (WFO)
  - Kansas City & Pleasant Hill, MO (WFO, RHQ, NWSTC/OPG, MBRFC)
- Western
  - Boise, ID (WFO, NIFC)
  - Elko, NV (WFO)
  - Sacramento, CA (WFO, CNRFC)
  - Seattle, WA (WFO, CWSU)
- Alaska
  - Anchorage & Palmer (WFO, RHQ, APRFC, NTWC, AAWU)
  - Fairbanks (WFO)
- Other
  - NCEP (SPC, NHC, AWC, EMC, WPC) in College Park, MD; Miami, FL; Norman, OK; and Kansas City, MO

- **Phase 1 site visit plan** enabled ~42 site visits to distinct offices in 20 locations:
  - 16 WFOs
  - 6 RFCs
  - 5 NCEPs
  - 4 Regional HQs
  - 3 CWSUs
  - 2 TWCs
  - 1 NIFC
  - 1 CPHC
  - 1 AAWU
  - 1 DCO
  - 1 ITIC
  - 1 NWSTC/ OPG
- **During Phase 2,** additional sites will be visited

WORKFORCE FINDINGS

Exhibit 72: Table of Organization and appropriated positions



1: Data from Table of Organization for NWS; not included are the 87 pathways positions (7 filled) or unfilled temp billets
2: In 2015, NWS was appropriated 4,638 billets
3: 72 of the 110 reimbursable positions are filled

Exhibit 73: Workforce and workload model

	Workload driver	Impact
Statistically significant[1] (N=770)	• Population • Population density	• Larger population leads to increased potential for loss of lives and property and to larger number of IDSS stakeholders
	• Marine area of responsibility	• Larger marine area of responsibility increases expected workload
	• Land area of responsibility	• The larger the area of responsibility, the higher the expected workload
	• Number of watches, warnings, and advisories	• The higher the number of WWAs, the higher expected workload in office[2]
	• Aviation responsibilities (e.g., number of forecast airports)	• The higher the number of airports covered by WFOs, the higher the expected workload
	• Regional location[3]	• Regional differences lead to additional variation in expected workload
	• Severe weather events and cost	• Number of severe events increase workload and average cost for severe weather event
	• Non-precipitation event	• Number of non-precipitation events
Not currently significant	• Other weather events	• Count of events not individually significant: fire, tropical, winter, marine, heat, and flood
	• Cost of other weather events	• Average costs of events not categorized as "severe"

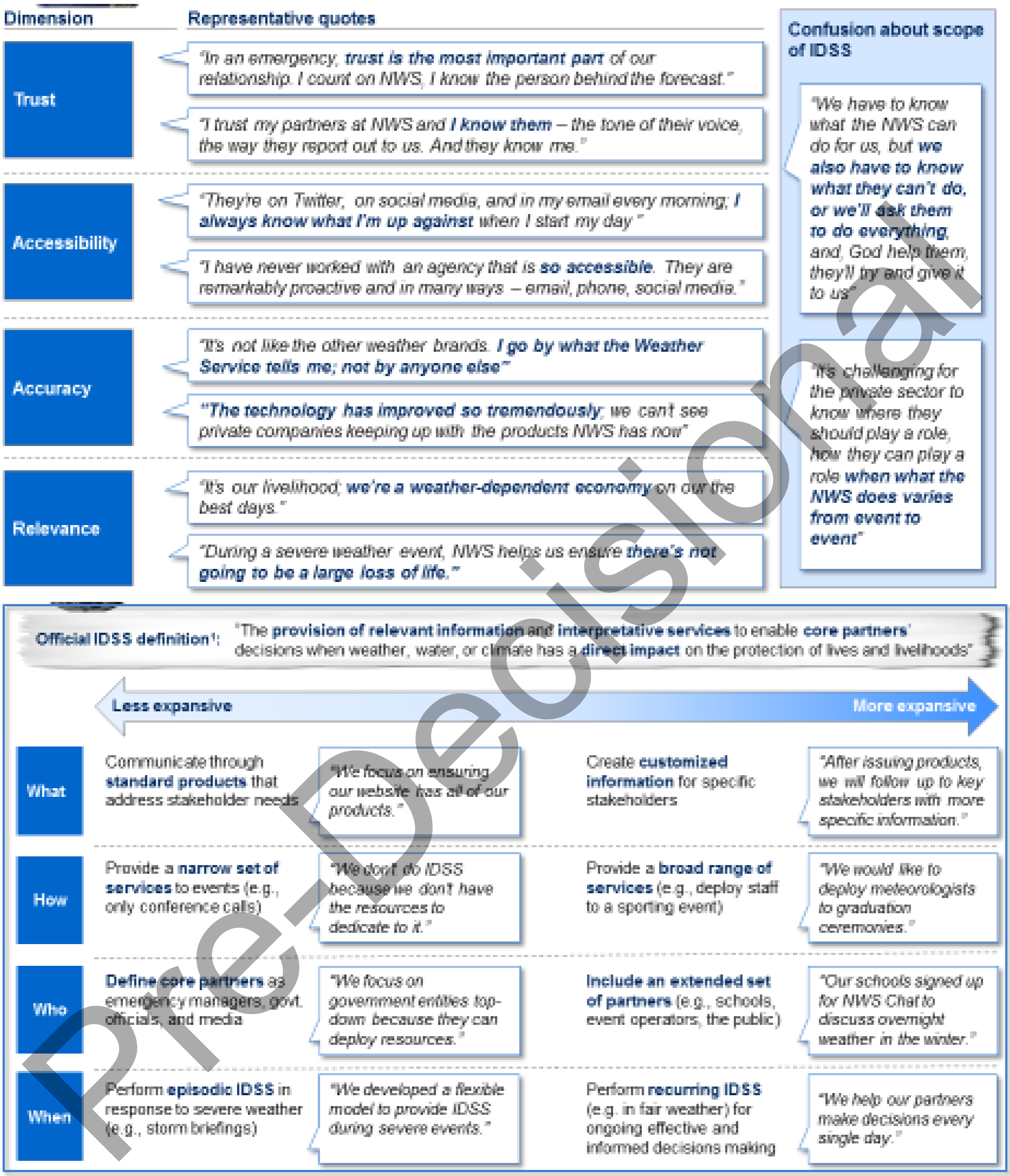
1: Statistical significant variables all significant to 95th percentile for 2008-2014, treating each year and WFO as an independent observation; F-statistic 32.02 with a confidence interval of >99%; all included variables statistically significant in the 95th percentile; r-squared for regression = .5392

2: Offices included in analysis currently only constitute WFOs; other types of offices (RFCs, CWSUs, WSOs) not included in sample as they would not provide a homogenous sample to compare office to office; to date the RFC statistical analysis has not yielded statistically significant results

3: in our model, the western and pacific regional variables were statistically significant, possibly because of unique drivers of workload not captured in other drivers (e.g., IMET program, manual observation requirements)

IDSS FINDINGS

Exhibit 74: IDSS interpretations



1 From the NWS Weather Ready Nation Strategic Roadmap

OHI OVERVIEW

Exhibit 75: OHI survey and methodology

What organizational health is

Organizational health is the ability of an organization to:
- Align behind common goals, strategy, and culture
- Execute with excellence to meet them
- Innovate and adapt to change

What the survey measures

- OHI survey was used to assess practices at NWS in order to show how they contribute to the organization's health and performance rather than employee satisfaction (covered in FEVS)
- OHI data set currently has over 700 organizations and 1.3 million respondents

About the NWS OHI survey

- OHI survey was open at NWS from June 8, 2015 to June 24, 2015
- Participation was n=2,162 with a response rate of 49% with a margin of error at the 95% confidence level
- The distribution of responses within the organization by office type and tenure and was representative of the overall distribution of the workforce
- NWS was compared to the OHI global benchmark as well as a public sector benchmark (27 surveys, n=47,159) and the professional scientific and technical services benchmark (27 surveys, n=17,849)

WARNING ANALYSIS

Exhibit 76: Verification vs. experience issuing tornado warnings

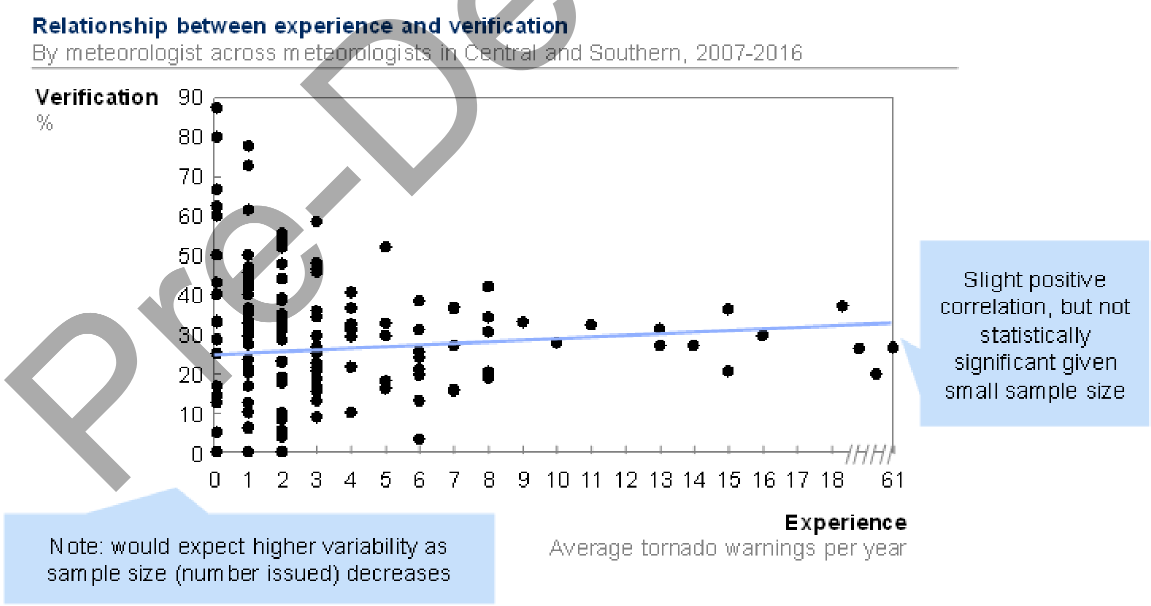
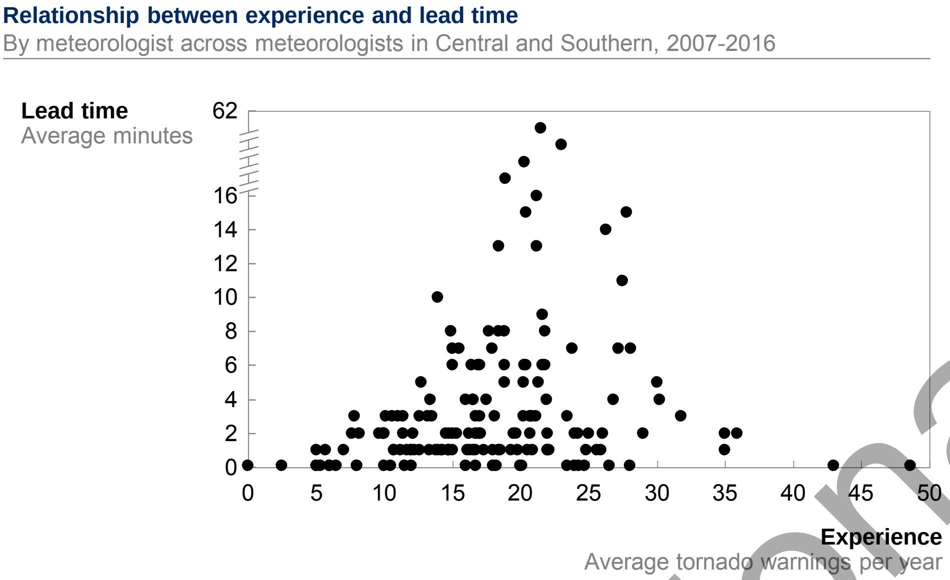


Exhibit 77: Lead time vs experience in tornado warning issuance



IDSS STAFFING LEVEL METHODOLOGY

Objective and need:

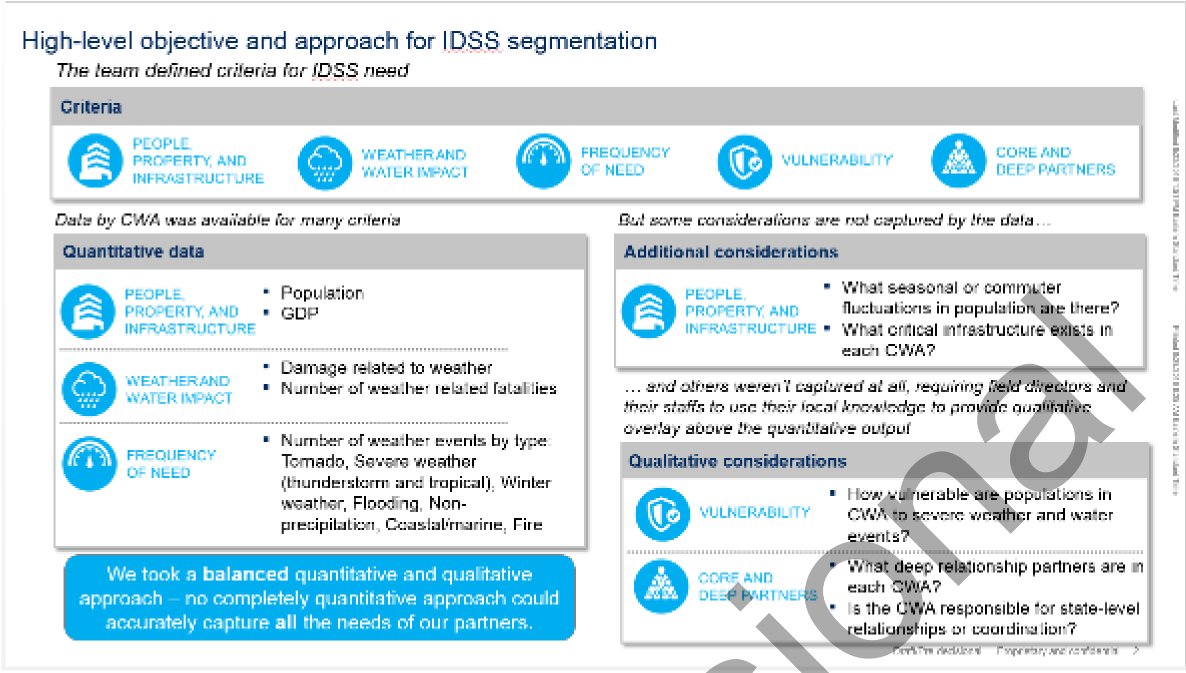
We saw in the Operations and Workforce Analysis (OWA) diagnostic that our cookie cutter staffing approach doesn't match the reality of where our people are needed today, much less where our people are needed in the future – as our workload continues to shift in line with our Weather-Ready Nation vision, which is about best serving our core partners.

When we consider the future form the NWS will take, we want to align our workforce to our most critical needs – putting our resources and expertise where the workload is the greatest.

To do this, we needed to build a model that allows us to estimate workload across each of our critical functions today and in the future, the most critical of which is the need for IDSS for our core partners, but also the expected workload for scientific development and training, met watch, observations and maintenance, administration, and leadership.

Early on, we identified a general mismatch between IDSS workload and workforce, with many important partners not being fully served today. Digging deeper, we found that there is unmet need for IDSS in many locations, so we set out to design a systematic approach to understanding this and other workload needs.

Exhibit 78: High-level objective and approach for IDSS segmentation



Step 1: initial quantitative analysis

To align workforce and workload, we set out to build a strategic workforce planning model, built on as many quantitative criteria as possible, supplemented with the judgment of our field leadership.

To define the quantitative criteria most important for driving our workload, we engaged the Regional Directors (RDs) and other field leaders (MICs, HICs) in a workshop, where we built the first draft of the criteria for estimating workload for IDSS, this included data by CWA on people, property, and infrastructure; weather and water impact; frequency of need; vulnerability; and needs of core and deep partners.

The rationale for each criteria is as follows:

People and property. CWAs with greater levels of people and property (all else being equal) will have a greater IDSS mission. For example, populated areas may have a greater number of organizations that require support during an event. Data considered include population, population density, seasonal variation in population, and GDP.

Weather. Offices with higher significance weather events will tend to require additional IDSS. For example, there may be additional training required for emergency managers in locations impacted by hurricanes. Data considered included types of weather that affect the region and loss of life events in the region.

Frequency. Offices that contend with extreme weather more often will tend to require higher IDSS. For example, locations with more frequent floods may require additional IDSS resources to spin-up more often. Data considered include how often watches, warnings, and advisories and spot forecasts are issued.

Vulnerability. Offices with people and property more susceptible to weather will require higher IDSS. For example, coastal areas that require evacuations before events may require additional IDSS support in making impact decisions. A vulnerability index, paired with regional expertise, can be used.

Core and deep partners. Offices with additional customers will tend to require more IDSS staff. For example, the NYC area may require additional IDSS due to national security risks. Data considered can include review of institutions in the area and local office partner lists.

Step 2: initial qualitative overlay by field leadership

Each RD left the workshop with the criteria and data, grouped by CWA, and were asked to apply their own qualitative judgement and expertise to that data to come up with an initial "segmentation" of offices -- a grouping of each of the 122 WFOs into either a Low, Medium, High, or Extreme IDSS demand bucket.

Step 3: creating a nationally consistent picture, with quantitative and qualitative factors

In order to create a nationally consistent picture, we combined the inputs from the RDs, and standardized and calibrated the segmentation drafts, refining the criteria in the process and ensuring they were applied uniformly across the regions. The output from this session was the next draft of the segmentation.

What also resulted from this session was the final list and descriptions of the criteria for estimating IDSS demand.

Step 4: combine quantitative and qualitative into one usable model

The OWA team then built a unified, quantitative, dynamic, and replicable model based on the final list of criteria and all the data sources. This model can then be updated over time to incorporate new underlying data, but the “coefficients” on each data element are able to stay the same.

The model also formally incorporates the judgment and experience overlaid by regional leaders. We knew going into the exercise that there would always need to be a qualitative element to capture the nuances of different partner needs, especially as we do not have a final partner database as of yet.

For now, we have sound, reliable data by CWA for three of the five criteria categories:

1. People and property:
   - Population
   - Gross domestic product (GDP)
2. Weather and water impact:

- Damage related to weather events
- Weather related fatalities

3. Weather frequency
   - Number of weather events

For the last two categories, some data is available but the data quality was such that we were not confident with its reliability or connection to true workload drivers at this point, for example:

4. Vulnerability:
   - We had access to data on household income, housing type, languages spoken, and other items from the U.S. Census, but were not confident that the data adequately represented the spirit of the criteria in the same way our other sources did.
5. Core and deep partners:
   - The only data we have at this point is what we collected from each field office via a data request earlier this year during the "IDSS table top exercises." This data has been highly informative but is not mature enough to use to assess demand – offices are still working to prioritize their partners, identify unmet needs, and refine their partner lists. We also promised the field at the time we collected that data that we would not use it for demand analysis.

As such, we did not attempt to model these two factors quantitatively at this point.

For the first three criteria, we constructed a model that created a standard score (sometimes referred to as a z-score) for each office on every dimension and sub-dimension of the criteria. We then aggregated those criteria using a weighting that privileged loss of life and property (among a few other considerations). This left each office with a standard score for IDSS need, expressed in terms of their distance from the mean score.

Exhibit 79: Example output of the IDSS-demand segmentation model

Identifiers	Outputs		GDP	Impact		Frequency					Special		
WFO	Final Output	Weighted sum	GDP (z-score) 0.182	Damage (z-score) 0.091	Death (z-score) 0.182	Tornado 0.091	Non-precip 0.045	Winter 0.091	Flooding 0.091	Severe weather 0.091	Special marine 0.045	Coastal flooding 0.045	Fire spot forecasts 0.045
ABQ	Medium	0.02	-0.37	-0.36	-0.08	0.16	1.33	0.74	-0.36	-0.04	-0.46	-0.42	1.62
ABR	Low	-0.45	-0.69	-0.68	0.49	-0.65	-0.58	-0.42	-0.69	-0.98	-0.46	-0.42	-0.71
AFC	Medium	-0.18	-0.57	-0.56	1.60	-1.31	0.68	0.36	-0.89	-1.67	-0.45	-0.15	
AFG	Low	-0.31	-0.66	-0.65	0.91	-1.38	-0.05	0.55	-1.01	-1.70	-0.46	0.74	0.33
AJK	Low	-0.61	-0.72	-0.71	0.78	-1.41	-0.32	-0.63	-1.33	-1.72	-0.42	-0.34	-0.89
AKQ	High	0.27	0.19	0.21	-0.70	0.83	-0.57	0.01	0.01	0.80	1.82	3.12	-0.15
ALY	Medium	-0.13	-0.12	-0.11	-0.99	-0.68	0.52	1.75	0.46	-0.08	-0.46	-0.42	-0.79
AMA	Medium	-0.14	-0.58	-0.57	1.70	-0.49	-0.05	-0.48	-0.75	-0.57	-0.46	-0.42	-0.84
APX	Low	-0.62	-0.63	-0.62	-0.68	-1.09	-0.89	0.27	-1.11	-0.91	0.14	-0.39	-0.43
ARX	Medium	0.11	-0.52	-0.51	-0.18	0.55	-0.65	0.23	1.76	1.73	-0.46	-0.42	-0.71
BGM	Medium	-0.23	-0.04	-0.03	-0.69	-0.43	-0.53	0.55	0.18	-0.16	-0.46	-0.42	-0.83
BIS	Medium	-0.13	-0.57	-0.56	1.04	0.16	-0.54	0.11	-0.83	-0.41	-0.46	-0.42	-0.30
BMX	Extreme	0.55	-0.14	-0.13	1.26	2.14	0.53	-0.40	0.36	1.64	-0.46	-0.42	0.82
BOI	Low	-0.60	-0.54	-0.53	-0.69	-0.95	-0.61	-0.23	-0.89	-1.12	-0.46	-0.42	0.54
BOU	High	0.39	0.48	0.49	-0.75	0.60	0.97	2.38	0.13	0.42	-0.46	-0.42	1.54
BOX	Extreme	1.01	2.42	2.44	-1.08	-0.67	2.98	1.25	1.40	0.46	1.08	3.65	-0.58
BRO	Low	-0.63	-0.53	-0.52	-0.87	-0.74	-0.82	-1.17	-0.51	-0.71	0.11	0.17	-0.45
BTV	Low	-0.39	-0.54	-0.53	-0.46	-1.21	0.13	1.24	-0.28	-0.67	-0.46	-0.42	-0.86
BUF	Medium	-0.16	0.17	0.18	-1.10	-0.95	-0.36	0.72	-0.07	-0.06	0.76	1.12	-0.90
BYZ	Low	-0.38	-0.67	-0.66	0.49	-0.79	-0.23	0.00	-0.97	-1.04	-0.46	-0.42	0.39
CAE	Low	-0.38	-0.35	-0.34	-0.76	0.25	-0.90	-1.11	-0.44	0.57	-0.46	-0.42	-0.03

We then 'bucketed' offices into the same four need categories the RDs had used previously (Extreme, High, Medium, and Low). Offices that were half a standard deviation or more below the mean were labelled 'Low', those between one half below and above the mean were 'Medium', between one half and one standard deviation above the mean were 'High', and those greater than one standard deviation above the mean were 'Extreme.'

We then overlaid the RD's assessment of vulnerability and core and deep partners to create a final model-driven segmentation, which can be updated over time.

Step 5: compare the initial field leadership output with the consistent national picture

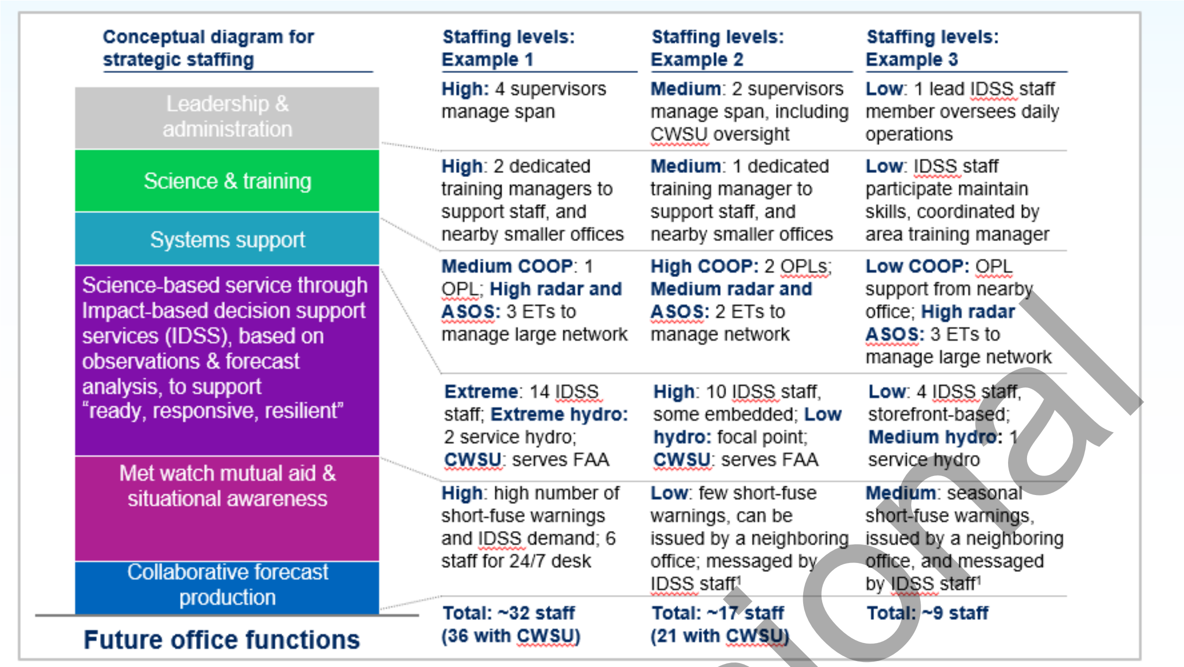
So now we had output from a nationally consistent model, against which we could compare the RDs initial approach to test how close their first cut was versus the final output.

We compared the quantitative model and the RD's draft output, and found that the model predicted the segment of 50% of offices the same as the RDs, and 95% of the offices within one segment (i.e., model says 'low' vs. RDs say 'medium').

RDs did one final comparison of the model output versus their judgment in September 2016, especially on the qualitative factors around vulnerability and partner needs, and finalized the IDSS demand estimation map.

NWS field leadership can also peer review office segmentation to validate that offices with similar characteristics across regions are segmented similarly. Ongoing testing and evaluation is needed to clarify segments.

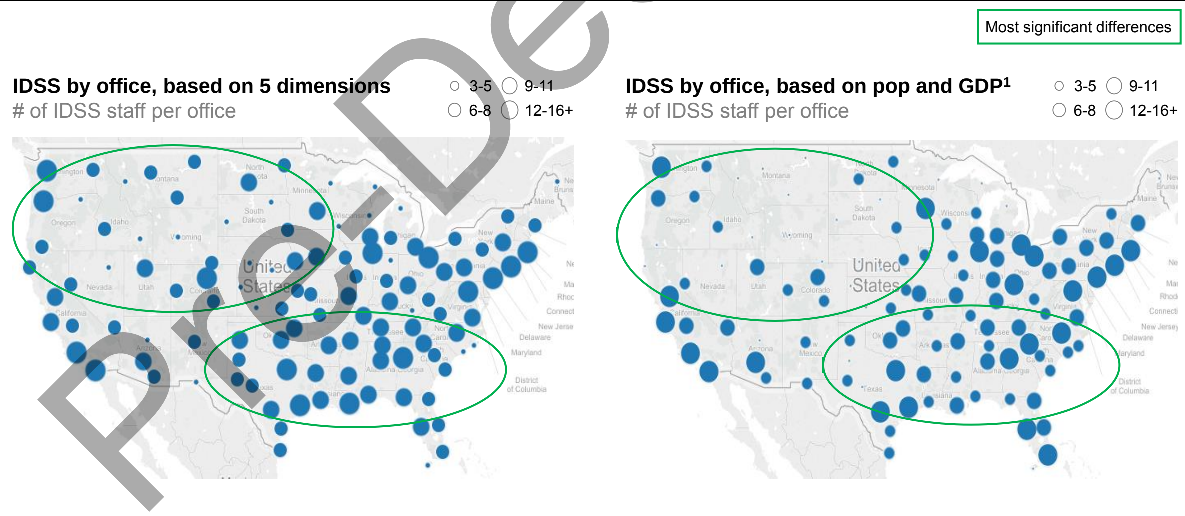
Exhibit 80: Potential staffing levels by different demand layers



1 Staffing for warnings to be determined using multiple criteria not shown here, including partner needs, climatological areas, and sufficient scale for warning operations

Importantly, this methodology is not purely based on population; if NWS were to staff based on population alone as the indicator of demand, Western offices could have fewer staff than in the model with the methodology used.

Exhibit 81: Comparison of different staffing methodologies



1 Segmentation of offices into quartiles based on population and GDP, then combined into overall segments with equal weighting of population and GDP quartiles

Water services IDSS methodology

A similar process was also developed for Hydrology IDSS demand, the process for which and initial thinking are explained in the exhibits below.

Exhibit 82: Methodology for estimating water services IDSS demand

1. Identify potential need for strategic staffing
2. Develop dimensions and measures
3. Apply dimensions to each WFO
4. Aggregate dimensions and refine output for overall IDSS segment
5. Apply operating models

Exhibit 83: Dimensions for water services demand

② Develop dimensions and measures

Primary criteria with quantitative measures for each dimension

Flooding
- Combination of flood warning quantity, flood warning length, and flooding impact

Water supply management and drought
- Combination of drought types (particularly, severe)

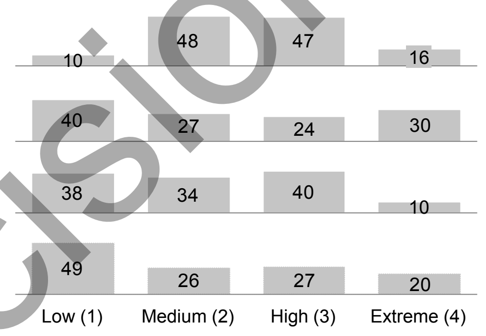
People and property[2]
- GDP and population in the area
- Transportation (navigable river miles)

Vulnerability
- Extent to which people and property may be disproportionately impacted by water-related phenomena requiring IDSS

Further requirements
- Potential demands of verifying forecast points and maintaining water observation network
- High-demand partners (e.g., significant ports/dams)

③ Apply dimensions to each WFO

Number of WFOs in each segment[1]

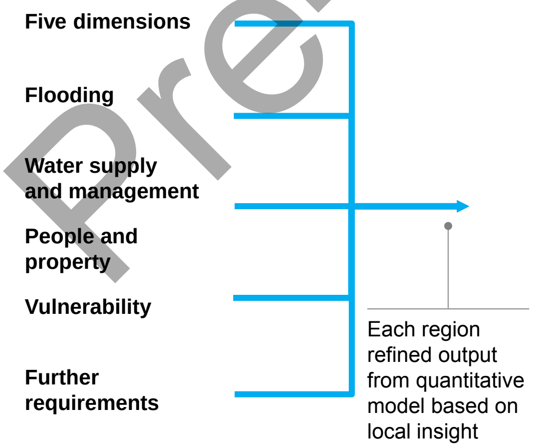


Applied qualitatively by directors

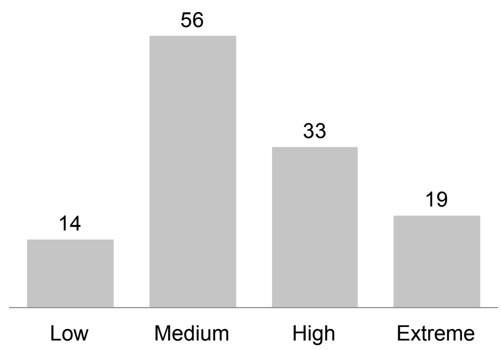
1 Segmentations used quartile ranges for raw data, then aggregated with cutoffs. Extreme had average >3.5, high average >2.5, medium average >1.5, low average >1
2 Weighted with GDP and population as 75% and river miles as 25%

Exhibit 84: Distribution of offices by IDSS demand

④ Aggregate dimensions for overall IDSS segmentation



Estimate of number of offices by IDSS segment



1 In addition to 122 CONUS and OCONUS WFOs, strategic staffing also considered Guam in Pacific region

Exhibit 85: Potential staffing model for water services at WFOs

⑤ Apply operating models

	Description	Potential roles
Extreme	▪ Dedicated water team, overseen by senior hydrologist and including support from one other hydrologist in addition to further IDSS resources	Water lead (Senior SH); Hydro-trained IDSS; Service hydrologist; Hydro-trained IDSS
High	▪ Trained hydrologist provides support and oversees cross-trained met (or other individual) who assists full-time in water	Water lead (Senior SH); Hydro-trained IDSS
Medium	▪ Individual service hydrologist dedicated to water IDSS ▪ May be cross-trained met, depending on water needs in area	Service hydrologist
Low	▪ Individual with hydro training in office to provide touch point for hydro IDSS, supported by neighboring office	Hydro focal point; Neighboring SH

▪ To be refined after IDSS tabletop and further water services meetings