National Weather Service

Report of the Concept of Operations Tiger Team

PREDECISIONAL AND DELIBERATIVE

December 16, 2005

Foreward

This report was produced by a team of National Weather Service employees chartered by the National Weather Service Corporate Board (see next section) and provided to the Board for its further deliberation and action. Therefore the report itself is a deliberative, pre-decisional document – all further actions taken based on this report will be the result of decisions made by the NWS Corporate Board. The report is being published in the interest of transparency to provide NWS employees and other interested parties insight into the development of NWS plans.

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Concept of Operations Team Charter

Problem Statement

We are working under a fundamentally flawed Concept of Operations (CONOPS), which has evolved without an agreed-to approach to the digital era, a problem that is being exacerbated by increasing budgetary pressures.

Goals and Objectives

Develop an NWS-wide Concept of Operations that provides a concise description of the apportionment of all operational functions and tasks required for mission performance throughout the NWS, both CONUS and OCONUS.

The CONOPS must be based on sound scientific principles and technologies, resulting in an NWS that

-supports efficient production of a digital forecast database and deterministic and probabilistic products, delivered to a diverse user community;

-provides a wide spectrum of improved climate, weather and water services, with special emphasis on high-impact events.

-provides an infrastructure leveraged by NOAA to promote its goals

-works in partnership across the weather enterprise (all government, academic, and private sectors)

-delivers a full array of environmental services

-clearly addresses roles in observation, forecast, warning, and dissemination;

-has a resilient service delivery system, quickly adjusting to interruptions in support systems (e.g. communications, power) or facility damage

-ensures a flexible and agile organization that can address future needs;

-promotes organizational effectiveness and optimal use of resources across all levels, allowing employees to experience a high quality of work life.

Scope

Guiding Principles:
- No degradation of service
- No reduction in number of offices

- Equitable services across the nation
- Cost effective
- Do not address grade structure, staffing levels, office size, org-chart
- Solicit input from the workforce in accordance with the CBA
- Test key features within 18 months

Must Address:
- Roles and responsibilities of WFOs, RFCs, CWSUs, National Centers
- Collaborative forecast process
- Digital services/grid production
- Observation, analysis, forecast and warning production, dissemination
- Possible redistribution of functions
- Opportunities for expansion of NOAA environmental services

Roles and Responsibilities

Director:
- Chair reports directly to Director.
- All major problems will be resolved here if not before.
- Final approval authority for charge, charter, and team output.
- Maintains 51% of Board voting authority.
- Maintaining communication of progress w/ NOAA as appropriate.

Corporate Board:
- Remains intellectually engaged with Tiger Teams.
- Advisory role maintained mainly through the Team Champions.
- Available to team chairs for advice and/or resources if called upon.
- If first level supervisor to a team member, role is limited to advisor and to fully support (resources) as necessary.
- Upon delivery, role is to review/advise on delivery.

Champion:
- First Board level support to team chair and team.
- Liaison between Corporate Board and team chair.
- Help ensure resources are provided as necessary.
- Role limited to supporting/advising and enabling the team, not managing or directing
- Ensure three team's efforts are integrated.

Chair:
- Responsible for the Team, and final deliverables.
- Reports to the Director at pre-set intervals, between as necessary.
- Seeks advice from Champion.
- Communicates to the Board through the Champion, and through pre-set briefings.
- Ensure three team's efforts are integrated.

- Provides deliverables as scheduled.
- Solicits input from the field using COM office or other means.
- Has this task as their number 1 priority.

Tiger Team:

- Report to Chair.
- Works as a team with Chair to develop all deliverables.
- Has this task as their number 1 priority.

Key Objectives and Timeline

Key deliverable is a (draft) concept of operations delivered to the Corporate Board by December 16.

Calendar Year 06 demonstration project(s)

I. Executive Summary

The Concept of Operations (CONOPS) Tiger Team was chartered by the Director of the National Weather Service (NWS), Brigadier General D.L. Johnson, USAF (Ret.), and completed its work via a series of meetings and conference calls beginning in August 2005. The key deliverables were a recommended CONOPS and a prototyping activity for consideration by the NWS Corporate Board. CONOPS team members are identified in Appendix A.

During deliberations, the team reached consensus defining the current state of NWS operations, the case for change, and the future state (2015) CONOPS. In all cases open discussion was encouraged and preceded the finalization of recommendations. In some instances it was necessary to note dissenting opinions. The dissenting opinions are included in Appendices C and D of this document. The team reached agreement on a core set of philosophies (one dissenting opinion, see Appendix C) and identified key shifts from current operations to the future vision as a foundation for developing the CONOPS. Following those principles and key shifts, the team developed the CONOPS design and prototype activities.

Meetings were held at various locations around the country allowing team members to meet with NOAA partners and gather input from different levels and interests within the NWS. Sub-teams were formed to work on specific tasks and report back to the full Team. Team Champions (Dennis McCarthy and Vickie Nadolski) were present at some meetings and were contacted as necessary for clarifications and feedback. SRA Touchstone facilitators attended most full team meetings and assisted in the development of status briefings and final deliverables.

The team considered multiple alternatives before making its recommendation for a clustered peer office concept. The recommended concept maximizes distributed local expertise with a focus on high impact events while providing efficiencies in the production of routine environmental information. This concept clusters offices with common ecosystem, forecast, and warning challenges (which, when supported with technology, provides a platform for load balancing lower priority duties in response to and preparation for high impact events). The clustered peer approach is designed to collaboratively leverage expertise across all levels of the NWS, enabling the provision of enhanced services, utilizing resources freed from routine forecast activities during low impact situations. The concept supports close proximity to partners and customers making resources available to assist in

environmental information interpretation during high impact events. It also strengthens the NWS's position as potential service outlets for other NOAA agencies.

To minimize risks, the team recommends multiple demonstration areas to prove and refine the concept before full implementation. These demonstration areas should encompass different weather regimes and partnering opportunities with NOAA and other government agencies. Initial efficiencies in the clustered peer approach will be the ability to provide enhanced impact interpretation service while maintaining forecast and warning information quality with equal or fewer personnel resources. Anticipated enhancements in forecast modeling and technology offer opportunity for increased efficiencies in the future.

II. Current State: How NWS Operates Today

The NWS delivers a broad spectrum of climate, weather, water, and space weather services through the coordinated activities of 122 similarly-staffed Weather Forecast Offices (WFOs), 13 River Forecast Centers (RFCs), 9 national centers which comprise the National Centers for Environmental Prediction (NCEP), 21 aviation Center Weather Service Units (CWSUs), and other support offices around the country. Predictive weather services (outlooks, forecasts, watches, warnings, advisories, and other supporting information) are produced through a process that incorporates observational data, numerical model output and statistical guidance, and human expertise. These services are delivered in many forms, including textual, digital, and graphical formats. Most forecasts contain explicit prediction of various weather or water elements (e.g., temperature, wind speed, water level, various geomagnetic indices, etc.), although some impact information is included when known (e.g., anticipated road conditions or flood inundation). Most of the forecast information provided by WFOs is deterministic in nature. Probabilistic forecasts are provided by some national centers (TPC, SPC, and CPC, for example). Local offices and regional and national centers coordinate as needed in the preparation of these services. The majority of the coordination takes place via telephone communication, text-based discussions, and "chat" software.

When high-impact weather or flooding conditions threaten a particular area, local Weather Forecast Offices typically call in extra staffing on overtime to respond to the increased workload. Generally, the extra staffing are needed to support both hazardous weather/flooding operations and the continuation of routine services, although prioritization ensures the most critical actions are taken first. In the event a local office becomes unable to provide forecast and warning functions, a continuity of operations plan allows an office

that is often adjacent to the incapacitated office to assume those duties temporarily. This is accomplished by restarting a forecaster's workstation in a service backup mode which emulates the stricken office's forecast area. Extra personnel are needed at the office providing backup to then generate products and services for the offline office's area of responsibility. National center backup is typically provided by other national centers (TPC backed up by HPC) or by parallel forecast operations within the Department of Defense (SPC backup is AFWA). River Forecast Center backup operations vary by office, and often require taking a laptop PC to a remote location with Internet access. For some hazards (typically large fires), Incident Meteorologists (IMET) stationed at some offices are deployed with remote observing and forecast capabilities.

National Weather Service facilities at all levels engage in internal training and professional development and external coordination and outreach on an ongoing basis. These activities are normally conducted during periods of relatively quiet weather conditions, and are in addition to the continued provision of routine observational and predictive services. Feedback from outreach and external coordination often leads to new and expanded services in support of decision making by public officials.

Partners and customers rely on the NWS for reliable delivery of information and access to databases. The NWS relies on these effective partnerships to better understand and apply technology and science, continue the record of forecast improvements, and meet expanding needs for high quality weather, water, and climate services.

III. Case for Change: Why NWS Must Change

The NWS must change its concept of operations in order to remain relevant and effective in the nation's ever changing weather enterprise, and must make more effective use of resources in order to meet future budget challenges in a proactive rather than reactive mode. As society's requirement for cross-discipline environmental information continues to grow, the agency must adapt to meet these new needs while recognizing that fiscal constraints require reallocation of existing resources rather than expansion. A new concept of operations is also required to allow the NWS to assume a new and more

integrated role within the environmental information services of NOAA and to better leverage advances in science and technology.

Increasingly sophisticated decision-makers will require quantification of uncertainty in environmental forecasts. The workforce must be positioned by a new concept of operations focusing on providing decision assistance to partners in a world of complex ecosystem interactions.

Specifically, the NWS current CONOPS must change to build on the unique strengths of the agency, and at the same time eliminate obstacles to efficient use of resources. The NWS must take advantage of its presence in 122 locales to focus efforts on events with high impact on the public and other decision-making partners. This means the NWS must be able to use resources more efficiently during high impact events in order to provide an optimal service that is relevant to its customers. It also means the NWS must make better use of its resources during periods when impacts are minimal, so that the agency can better prepare to provide superior service during future high impact events. In order to optimize performance when it really matters, the agency must have an operational concept that is:

- Flexible, not one-size-fits-all
- Adaptable, not staffed the same regardless of the weather
- Impact-based, not driven by phenomena definitions
- Agile across organizational boundaries, not bound by them

The NWS must develop a workforce that goes beyond meteorological expertise to include other environmental systems and becomes more knowledgeable in the societal impacts of environmental events. The workforce at all levels of the agency must embrace a culture of collaboration rather than one of merely coordination. A new concept of operations offers the agency the opportunity to improve the quality of work life for its workforce by becoming a customer of its own expertise in making resource decisions.

A new concept of operations will keep the NWS relevant and effective in the future. Better utilization of resources will benefit both NWS customers and employees. (See Figure 1, below, for the Team's case for change slide).

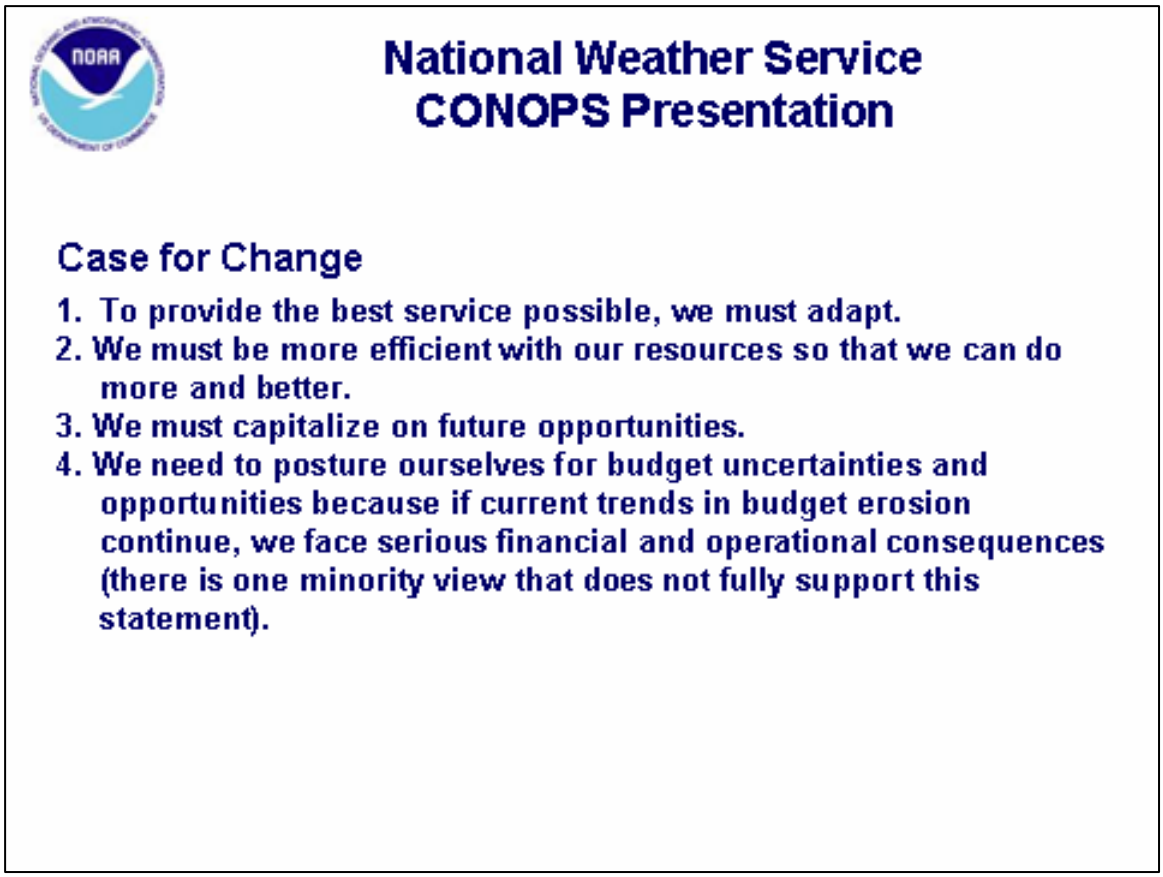

Figure 1 – Case for Change

IV. Future State: How NWS Sees the Future

A. The Future of NWS

The operations concept to be described is based on a vision of the NWS's future state which will evolve through a period of a several years; long enough for science and technology developments to allow the NWS to carry out its mission and contribute to the NOAA mission in new ways, gaining efficiency while increasing effectiveness. The time by which the future state will be in place is nominally 2015.

The component parts of this vision for the 2015 NWS include the market; customers and partners, information and services, technology, data, and tools, people, and NWS's identity (see Figure 2, below.)

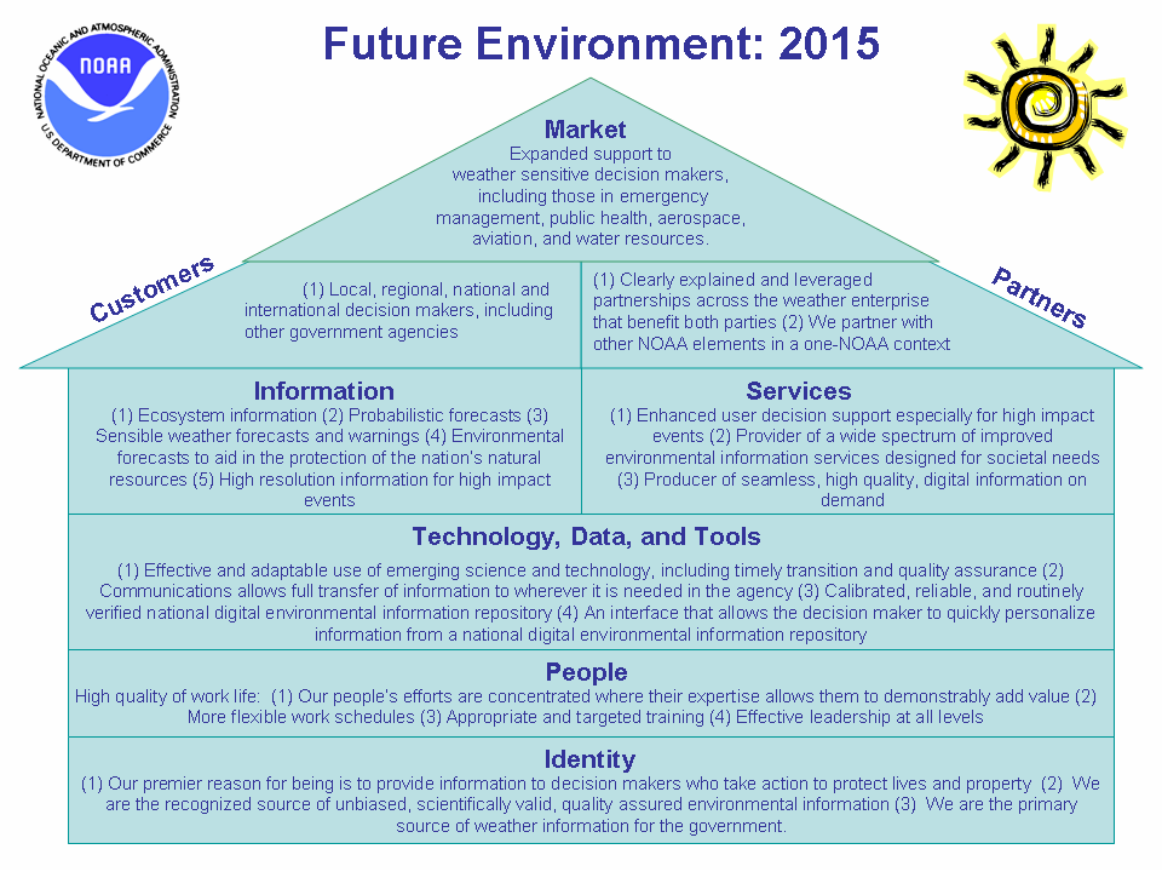

Figure 2. The NWS Future State

The market in the future is characterized by expanded support to weather sensitive decision makers both in events of nature and man-made incidents.

The customers and partners of the future include many of the traditional relationships, but with far more emphasis than in the past for assisting decision makers in factoring weather information into their response. Partnerships are expected to be more robust and more specifically defined across the entire weather enterprise. In particular the NWS will assume a significant new array of activities to support the larger mission goals of NOAA.

Information and services will be expanded significantly in the NWS of 2015. Many of the forecasts and warnings that are provided today will continue to be provided, with a greater ability to provide probabilistic forecast and warning information. In addition, improvements in guidance will allow the NWS to produce routine forecasts more efficiently. This guidance will also permit the NWS to provide probabilistic information associated with forecasts and warnings. Expertise will be freed up to support decision making for high impact weather and other events that require support.

NWS science, technology, data and tools will be a cornerstone of its accurate and comprehensive information and services. The NWS will use these tools to populate a calibrated, reliable, routinely verified digital environmental information repository. The information repository will support interfaces that allow decision makers to quickly format data to support their specific needs.

The success in becoming the NWS of 2015 and the ability to maintain relevance and viability well into the future will depend on the workforce. The NWS's future depends on keeping as many of its core experts in as many locations as can be afforded. The NWS will concentrate resources where they can best add value to the agency's information and services, while maintaining local expertise and customer interaction. The NWS will encourage and engender leadership in all areas and at all levels of endeavor.

Finally, NWS's identity in the future will be that it is the organization that makes the difference when it matters most, enabling people in harm's way to make potentially life-saving decisions and provide support to other decision makers who take action to protect lives and livelihoods. In addition to being the unquestioned source of weather information for the government, the NWS's performance and call to service will result in its recognition as the source of unbiased, scientifically valid, quality assured environmental information.

B. The Operations Concept Philosophy

To be robust and lasting, an operations concept needs to be based on a philosophy which characterizes the elements of the organization that make it unique. The philosophy of this operations concept is expressed in a set of twenty principles derived to describe the core beliefs and behaviors of its people (see Appendix B). One dissenting opinion on the validity of principles 17 and 19 is presented in Appendix C, part 1. The final operations concept must be tested against each of the principles to ensure that it promotes the strengths of the organization.

i. Market

The NWS will ensure weather sensitive decision makers have ready access to high value environmental information. Critical decisions involving the protection of life and property, the national economy, and the protection of the nation's environmental resources, require the timely provision of accurate and reliable environmental information.

ii. Customers and Partners

There are two principles specifically that address the NWS' relationship with customers and partners. First, proximity to customers and partners is key to achieving and maintaining the quality of our information and services. If the NWS is too far removed from its customers and partners, it will fail as an agency to understand their needs, and will ultimately fail to meet those needs effectively. To ensure success with its customers and partners, NWS will engage in information design (ask them what they want) as close to the customer and partner as possible. In addition, NWS will engage local, state and national decision makers in dialogue, and will understand both what information customers and partners need and how they will use this information.

The second customer and partner principle states the credibility of NWS is a primary asset that will be maintained at all costs. Customers, partners and decision makers must continue to have confidence in NWS forecasts and judgment in order for NWS to maintain credibility. To make sure NWS does its best to maintain credibility, it will have a systematic way to understand and manage the quality of its information and to ensure that information and services meet expectations.

iii. Information and Services

There are four principles related to the service and information that NWS provides. The first addresses a balance between efficiency and effectiveness (*i.e.*, the degree of consistency and accuracy of NWS information corresponds to the value it provides.) Consistency and accuracy are essential to the credibility of NWS services, however resources are limited. Consistency is the degree to which information is laterally, vertically, and temporally coherent with respect to the physical processes that bind them together (environmentally realistic). In the effort to achieve accuracy and consistency the NWS will optimize the number of assembly points that put data into the digital environmental information repository, gaining consistency while maintaining or improving accuracy. This requires commitment resources to verification activities which will support effective decisions involving work process.

A critical principle of NWS operations is that it will provide information that includes estimates of uncertainty and is widely recognized as credible and reliable. Probabilistic forecasts are needed to support enhanced user decision support (risk management). This approach means there will be a major change in the balance of deterministic and probabilistic forecast information, or more specifically, there will be a transition from the

provision of predominantly deterministic model guidance to calibrated and reliable probabilistic model guidance information

The NWS will enable reliable access to information and services in formats which meet customer needs. This principle is also related to credibility. Further, effective communication leads to efficiencies for the customer and efficiencies for NWS and encourages use of NWS information. This principle means the NWS will enable customers and partners to easily build their own products, in user specified formats, from the digital environmental information repository. This approach enables users to make better decisions faster. Of course, resources may require a balance between what the customer wants and what we can provide. Naturally, the infrastructure supporting the creation and delivery of environmental information will be designed and resourced with reliability in mind.

Finally, to the greatest extent that resources permit, NWS will measure the value of the services provided in support of high-impact events while acknowledging that not all aspects of the value of high impact services are amenable to objective measurement. These performance data will enable the NWS to more fully and appropriately assess the benefit of services relative to the cost. They also promote organizational credibility and highlight the value of NWS services. The NWS will use these performance data to determine where to focus limited resources to the greatest public good. Importantly, the NWS provides vital services during high impact events that do not lend themselves to measurement; just because NWS cannot measure these activities in the short-term doesn't mean we should not perform them.

iv. Technology, Data and Tools

There are five principles that describe our values with regard to technology, data, and tools, most of which arise from the fact that NWS is a science and technology based organization. The NWS must strengthen its ability to assimilate new developments in science and technology and recognize the rapid speed with which these developments take place. The NWS must also significantly reduce its time to market for new information services.

A cornerstone principle for the collaborative model the NWS will employ is the need for real-time verification. NWS will routinely verify and quality assure the digital environmental information produced and make these verification data readily available to forecasters and managers in order to ensure resources are used efficiently and effectively. The verification system should be tailored to include information that enables the NWS to

make resource decisions about services for high-impact events. In order to improve forecasts and better manage resources, feedback must be provided to forecasters and managers about where they do and don't add value. Included in this requirement is that numerical model output must be routinely verified. As a corollary the NWS will efficiently and fully leverage the investment in numerical forecast guidance to ensure this guidance is fully utilized by field offices. Toward this end, the NWS must ensure that native resolution model is made available to field offices in a timely manner. A greater level of diversity and effectiveness in NWS model capability is needed to deal with a wide variety of mission requirements. This principle means, among other things, that there may be local modeling capability to extend the central capability. The NWS must be careful to avoid duplication of effort and expense, and adequate resources for the central facility are crucial.

Because the NWS is a science and technology driven organization and must remain current to remain credible, it will facilitate the rapid transfer of new science and quality assured technology into operations. Quality assured technology means thorough testing of hardware and software applications must be accomplished before delivery to operating units. The surest way to accomplish this principle is through the development and utilization of operational test beds. Further, when designing systems, adaptability of technology is a criterion that is as important as initial cost. Because the needs of NWS customers and partners will continue to evolve and scientific discovery and technological advances will create new opportunities for information and services, the NWS will have to adapt quickly to these new conditions and requirements. Utilizing this design philosophy will promote the deployment of more effective operational systems with lower life cycle costs.

v. People

Success in changing the NWS culture and operating in new ways in the future is critically dependent on the collective output of the NWS workforce and the contributions made by individual employees. Thus, the unique needs of individual employees must be recognized. Effectively managing and leading this workforce requires that local leaders be granted the latitude to take actions which maximize morale and retention.

If employees feel their work is valuable and meaningful and their efforts are recognized, morale and retention rates will increase and the NWS as a whole will benefit. Applying human resources wisely means ensuring employees are focused on tasks where they clearly add value, with these tasks prioritized by mission need. The NWS must ensure employees receive the training necessary to implement new science technology and

information services, and reap the full benefit of NWS investments. Applying this philosophy will also improve morale and retention rates, as well as promote diversity in the workforce.

In order to ensure a NWS poised to be efficient, effective and relevant well into the future, resources must be dedicated to leadership training and succession planning. Effective leadership is the heart of an effective organization.

vi. Organizational Design

The remaining principles generally pertain to the structure of an effective operations concept. First, to gain efficiencies, operating units should be resourced according to mission requirements, recognizing the diversity in climate regimes, customer needs, and that all weather is local with needs and impacts closest to the event. In general, this implies a need to rethink the standard “one size fits all” resource model and assign resources based on probability of high impact events.

The attribute which distinguishes NWS from other providers of weather information and services is its ability to place as many of its expert employees in close proximity to our customers. The new operations concept maintains a distributed concept of services where local offices are responsible for making resource decisions. This practice will maintain and foster credibility and employee morale and place resources closest to high impact events where they can maximize benefit. To accomplish this within available resources, local offices will reach across the organization for resource support when necessary. Work load balancing will be accomplished by peer-to-peer lateral shifting. Local offices will perform equivalent, but not necessarily identical functions, and will not be subordinate to one another. Anticipated efficiencies will come from sharing forecast production activities among multiple offices and allowing an office to be open less than 24 hours a day from time to time to participate in activities to prepare for high-impact operations. Because shifting production will be a matter routine procedure, accountability will reside with the operating unit from which the information is delivered, regardless of where the environmental information is produced. Customer service will be improved because the employee delivering the information takes accountability end-to-end for any customer interaction and will work with whoever they need to within the organization to get the customer what they need.

To increase efficiency and effectiveness of operating with shifting routine functions, operating units are clustered by partnership opportunities, climatology, similar forecast and warning responsibility, and ecosystems. This peer-to-peer concept among like operating units with similar mission provides opportunities for efficiencies including strengthened

backup capabilities, leveraged science opportunities with partners, common programmatic and technical needs, a work-life component (i.e., shared operational support for long duration events), and provides an infrastructure leveraged by NOAA to support its goals (i.e., a NOAA in your neighborhood portal).

In the same way that operations are more effective when distributed, design is better when executed closer to customer. Thus, national and regional service program leads should be located at operating units in areas where the program is active. This means service design is decentralized and distributed as currently done with the Boise Fire Weather Center.

C. The Elements of the Operations Concept

The NWS's ability to take on new and larger roles will tax the resource base and will require significant shifts in the agency's culture. The most significant shift will be toward an organization-wide interdependence managed through a collaborative process. Because the NWS will not likely experience growth in resources, it will being doing more with the resources it currently has. This means that the NWS needs to find ways of doing its traditional routine tasks more efficiently. This will be accomplished by organizing the field structure into clusters arranged according to ecosystems, climate or weather regimes, customer/partner needs, or some combination of these characteristics.

Changes in societal demands for mitigation and recovery from disasters are leading the NWS to examine its role in response to significant, high impact events. Increasingly, it is evident a role is evolving for the NWS in events that are not initially caused by weather, but for which weather, water, and climate information is critical to support the response to those events.

Fundamental changes in routine forecasting will take place over the next several years. Improvements in guidance culminating in the availability of reliable, calibrated probabilistic grids of sensible weather elements will mean that fewer resources will be required for basic forecasting. The focus of most hydrometeorologists in NWS will increasingly become one of providing decision support and risk communication services, especially for decision makers involved in managing response in high impact events. Further, as the NWS assumes new roles in the evolving mission of NOAA, it will take on more non-traditional tasks of developing and delivering ecosystem and other environmental information and services.

Some organizational elements will remain generally the same during and after the development of the new operations concept. Weather Forecast Offices (WFO) will serve as a direct outlet for much of the decision support environmental information, including customer/partner interactions designed to help users learn how to access and use decision information (including probabilistic forecasts). River Forecast Centers (RFC) will continue to collaborate with associated WFOs, National Centers, and external partners in much the same way they do today, yet provide enhanced services. RFCs will provide expertise and expanded guidance to address a spectrum of growing needs ranging from risk based forecast and warning information necessary to mitigate the impacts of flash floods, debris flows, and river floods, to new water quality forecast information and expanded long range guidance necessary for water resource managers to best manage America's limited fresh water supply.

The aviation community will receive much of its information through Air Transportation Weather Offices (ATWO). Prototyping of ATWO locations and services will ultimately define the scope of their contributions to the aviation weather community. The National Centers (NCEP) will provide valued forecasts, guidance, and support to the rest of the NWS field structure, in addition to providing direct information and services as required to international and national customers. All of these elements will assume new roles in developing new information and services in the broader arena of environmental information as a new and larger role in the NOAA mission evolves.

The key to efficiency is improved collaboration which will allow the NWS to accomplish routine forecast responsibilities by shifting workload among offices so local resources can be focused on high impact events or preparation for events. An early or transitional result of the collaborative process will be improvement in the national grids (the current NDFD), as space and time consistency will be greatly improved. There is one dissenting opinion with regard to the capability of collaboration among peers to greatly improve forecast consistency across WFO boundaries, and this is presented in Appendix D.

For the collaborative model to be successful, several items need to be in place. The NWS will establish accountability throughout the agency for its forecast process and will improve technology to support forecasting across time and space boundaries. New and improved tools will include the ability to expand forecast domains and derive consensus forecasts from the grids of multiple offices. These keys to collaboration are discussed more completely later in this document.

The operations concept for 2015 and beyond does not consist of large structural changes for NWS, but it does require significant cultural changes. These key shifts in culture include developing a fully collaborative approach and going beyond coordination (see Table 1, below). The NWS's emphasis will be redirected from phenomenon based forecasts to impact based information and NWS will de-emphasize products in favor of decision support information and services. NWS will move from deterministic forecasts to probabilistic forecast and warning information. By anticipating technology developments and reducing time to market, NWS will become technology enabled. NWS will broaden its view of its role so that it moves from an inward looking agency to one that sees itself as a part of the larger weather enterprise.

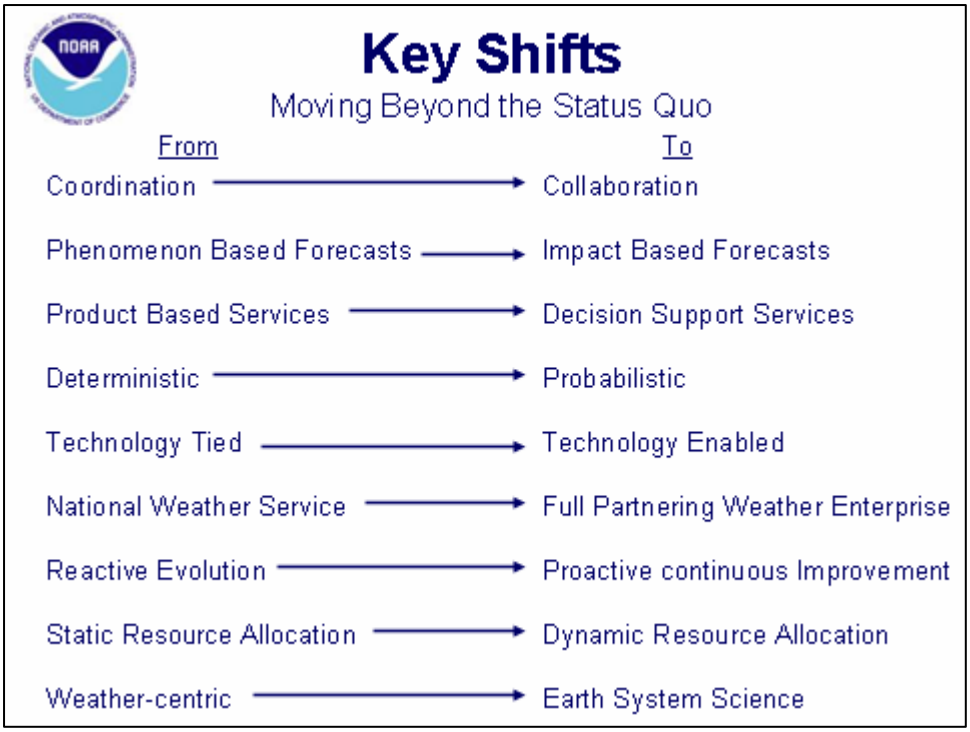

Table 1 - Key Cultural Shifts

D. Clustered Peers: An Operations Concept for 2015 and Beyond

The design for the 2015 CONOPS has as its focus the need to perform best during high impact events. It recognizes that the customer/partner relationship is NWS's most strategic asset. It allows NWS to concentrate on when and where value is added. The proposed CONOPS is structured to gain efficiencies by sharing workload across the organization (WFOs, regional and national centers) and enables load balancing which leverages resources during high impact events. It is predicated on the belief that a highly collaborative culture delivers exceptional results. It requires a reliable IT infrastructure and

support to enable effective performance. In addition, it enables more flexibility in work scheduling, which improves the quality of work life.

The CONOPS to be described is referred to as Clustered Peers. This concept can be characterized as one that focuses NWS resources on high-impact events while providing routine services in a highly collaborative process. It optimizes modern science and technology and is composed of mission staffed field offices at current facilities.

Clustered Peers refers to a structure of 122 field operating units, 13 River Forecast Centers and a number of Air Transportation Weather Offices that are aligned in a dozen or more clusters. The clusters are defined in a way that the peers share generally the same type of weather and warning responsibility, climate and/or customers and partners. Within a cluster, the WFOs all provide the same array of information and services, but have as a top priority decision support for high impact events. The peer WFOs will also support tactical meteorology, in a sense an expanded IMet program, to provide information and services during high impact events.

The WFOs may not all be staffed identically since staffing and resources will be based on mission needs. All offices will still be involved in the full array of routine services and be the final authority for local forecast and warning products and information. However, during periods of high impact weather these offices will focus all resources on the immediate impacts, and rely on load balancing through lateral shifting of tasks to one or more other offices in the cluster. In this manner resources across the cluster can be leveraged to support one or more offices involved in high impact events. It is conceivable that one peer office in the cluster would be able to support the routine services of all the other cluster offices during a widespread high impact event.

While routine forecasting still requires attention from the WFOs, technology that allows expanded grid domains larger than the present domains will be the key to improving national grids and creating cluster wide proficiency. This is the collaborated consensus forecast process. It will also provide resource efficiencies that permit offices to stand down for training or post event activities. Thus, it is possible that a WFO may operate less than 24X7 upon occasion.

National centers provide essential services to clusters and WFOs through centralized model output and statistical guidance, outlooks, forecasts, collaboration, and interpretation and expertise (especially as it relates to model bias and performance). National centers also provide watches and/or warnings directly to partners and customers (SPC, TPC, and SEC) typically through a collaborated process with other NWS elements.

Similar to their role today, River Forecast Centers provide guidance, decision support, and expertise both to WFOs and directly to some customers. Air Transportation Weather Offices provide a variety of aviation forecast services, including tactical decision aids, to the FAA and other aviation partners and customers. ATWOs also participate in a collaborative forecast process with cluster WFOs, national centers, and external partners

There may be one or more WFOs in a cluster that can take advantage of their proximity to additional resources in meeting the needs of the entire cluster. Examples of these nearby resources are RFCs, ATWOs, universities, NOAA labs, Regional Climate Centers, or other regional and federal agencies. Where these opportunities exist the WFO can be said to be a **cluster support office**. Additional resources may be placed in these cluster support offices to leverage their proximity to partners and resources for the benefit of the cluster and the NWS. They are not intended to be new structures in the NWS hierarchy. In this sense, a national center in proximity to a WFO could result in cluster support interactions through, for example, local experimental or research initiatives.

E. Alternatives Considered:

An important part of the process that the NWS CONOPS Team followed in the creation of a new CONOPS for the NWS was the identification and analysis of a suite of alternatives. The purpose of this section is to briefly identify and explain these alternatives in order that the value of the proposed future state CONOPS can be understood most fully.

The team defined seven alternatives as candidates for the NWS future state CONOPS. These alternatives spanned the gamut from complete centralization of all forecast and warning operations to nearly complete decentralization of all forecast, watch and warning operations. Alternatives “A” and “B” both incorporated the idea of forecast and warning operations centralization. Option “A” specified centralizing all forecast, watch and warning operations and option “B” specified centralizing routine forecast and watch operations while decentralizing warning operations. Both of these options were problematic in two ways. First, both of these alternatives were inconsistent with the 2nd NWS operating principle adopted by the team; “We believe that proximity to our customers and partners is key to achieving and maintaining the quality of our information and services.” Centralization of operations would inherently remove NWS forecasters, especially those engaged in critical warning operations farther away from customers. Secondly, the centralization of forecast and warning operations requires a level dependency on central guidance and forecasting capability that is not likely to be adequate for all portions of the United States; especially the

complex, mountainous terrain areas in the West. The members of the team unanimously concluded that centralization, while possibly being less costly, would result in the degradation of forecast, watch and warning timeliness and accuracy. This likely degradation would injure the credibility of NWS and would violate the 3rd principle adopted by the team; "The credibility of NWS is a primary asset that will be maintained at all costs."

Alternatives "C" & "D" centered on the concept of the clustering of local operating units with a tiered decision making structure within each cluster. These two alternatives centered around a three tier system of operating units (local – district – national) that would collaborate in sequence from most local to national to produce forecast information that was both consistent and accurate. An explicit element of both options was a collaboration process brokered by a decision making authority at each stage of the process. The ideal situation envisioned under these tiered alternatives was that improvements in centrally generated guidance and improvements in collaboration tools would result in collaboration generated agreement across the structure regarding the forecast; thus minimizing disagreement and the necessity for explicit decision making by the head of the cluster or by the lead national operating unit. A "solicit and decide" mechanism, dependent on open and thorough communication among the operating units in the structure with an emphasis on the obligation of the lead cluster and national operating units to listen to the perspectives of their local operating units, was also a key facet of these alternatives. Each these two alternatives also included a range of responsibilities at the most local operating unit. This range ran from full forecast and warning responsibility at the local unit to warning responsibility with no forecast responsibility to neither forecast nor warning responsibility at the local unit. Responsibilities not handled at the local unit would be handled at the district operating unit level. These different ranges of responsibility at the local unit level created some opportunity for other more value adding mission areas outside of traditional forecast preparation to be addressed by the local unit. Examples of these areas included increase outreach to local customers and users, more coordination with other NOAA localized mission areas such as ocean and ecosystems in order to support the local operating unit as the "one-NOAA" service outlet at the local level. Finally, these ranges of responsibility envisioned greater flexibility on the part of local operating unit leaders to staff and operate their units in a manner that better balanced cost, benefit and employee welfare.

Consistent with the 14th principle; "We concentrate the efforts of our people where their expertise and effort allows them to add value," the team members envisioned that local operating unit leaders would have the flexibility to participate in the forecast process when

they understood that they could add value and essentially "opt out" of the process on a given day (or forecast period) when they understood that they would not add significant value. The team envisioned that the improved verification capability driven by 9th principle; "We will routinely verify and quality assure the digital environmental information we produce and make these verification data readily available to forecasters and managers" will allow NWS forecasters to understand when and where they add value. The verification system should be tailored to include the information that lets us make resource decisions about services for high-impact events."

What differentiated these two clustered and tiered alternatives was the number of clusters envisioned. Alternative "C" envisioned a limited number of clusters, less than 15, while alternative "D" envisioned a larger number of clusters. The proposition behind alternative "C" was that in order for a collaborative process (bound by time and a decision making authority) to be effective, the number of entities involved in the discussion or collaboration must be limited. The team felt that the larger numbers of entities or units envisioned in alternative "D" was not conducive to a good balance between forecast, watch and warning quality and the amount of time and effort likely required to produce this information. Hence alternative "C" was considered viable and alternative "D" was generally not.

The fifth alternative analyzed by the team, alternative "E", envisioned a clustered and peered structure, as described in section 4D of this document).

The sixth alternative analyzed by the team, alternative "F", maintained the status quo in terms of NWS operating unit organization and the forecast process. Given the clear message in the CONOPS team charter, the team understood that this alternative was not viable.

The final alternative analyzed by the team, alternative "G", envisioned a nearly completely decentralized forecast, watch and warning operation with the only national operating units being the NCEP EMC, NCO and TPC. This alternative, while also theoretically possible, was recognized by the team as being inconsistent with proximity to the national and international NWS customers and did not provide a construct that would allow the 4th principle; "The degree of consistency and accuracy of our information corresponds to the value they provide," to be supported. Specifically, the team determined that further decentralization, especially in the area of national and internationally oriented environmental information, would only serve to worsen the current imbalance of consistency and accuracy.

After initial analysis, the team recognized that two of the alternatives were generally the most viable, alternatives “C” and “E”. After significant discussion where the majority of the team reached agreement, the clustered peer alternative was adopted as the recommended alternative for the future state NWS CONOPS. The majority felt that the previously mentioned four improvements to collaboration would greatly reduce consistency issues, and that creation of a new hierarchical structure primarily for the sake of consistency was not necessary.

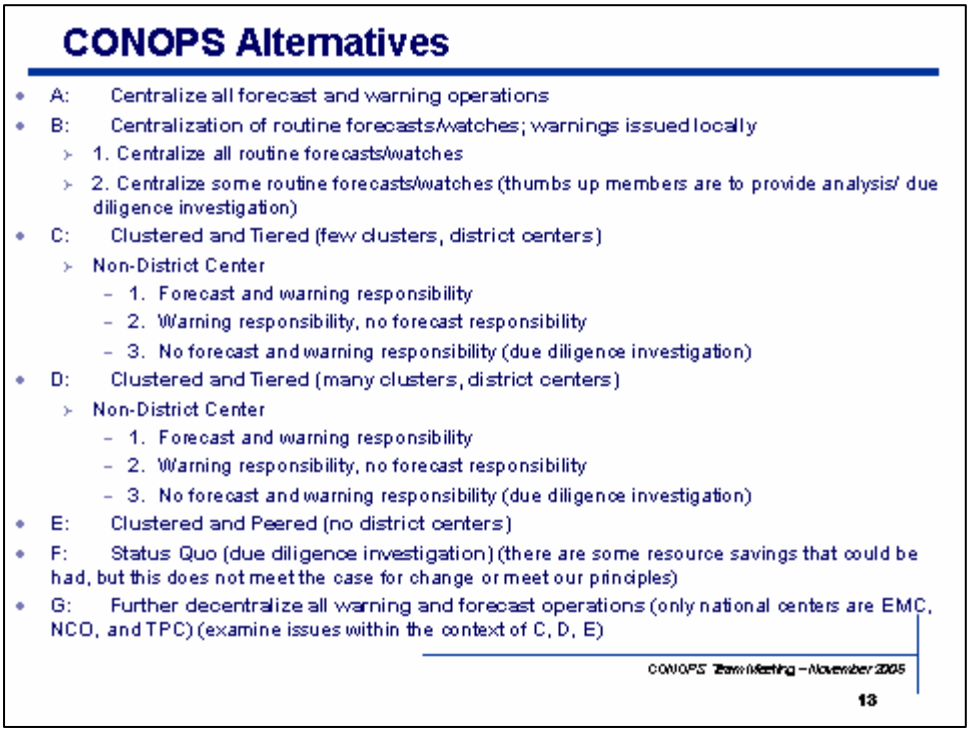

Table 2 – Alternatives Considered

V. The Way Forward: Strategy to the Future

The CONOPS Team agreed that there will be fundamental changes in the operations of an NWS forecast office by 2015. Advances in scientific understanding and improvements in numerical modeling will result in the routine availability of reliable, calibrated, probabilistic forecast guidance that will contain explicit expression of uncertainty and require relatively little forecaster manipulation down to the mesoscale level. In this 2015 forecast environment, the role of local forecasters becomes increasingly (though not exclusively) one of interpretation and communication, especially with regard to high-impact conditions. The process of interpretation and communication will focus on the growing NWS role in decision support assistance to local officials. This increasing role in decision support will span time

scales ranging from minutes for severe local storm warnings to seasonal and beyond for climate forecasts and impacts.

The team was in broad agreement that the path forward to 2015 will require significant changes in several key areas. These include some aspects of NWS culture and emphasis on collaboration, the tools needed to develop the most consistent and coherent forecasts and other services, and clearly articulating the expectations and accountability for performance in all areas of NWS operations.

Culturally, changes in three key areas will be essential to success. First, the NWS must evolve into an organization that becomes the customer of its own forecasts and expertise, using anticipated periods of relatively quiet weather to offload routine services in support of activities that further other NWS and NOAA objectives. For example, WFOs within a cluster can transfer most routine services to a peer WFO on a given day to conduct preparations for high-impact weather, such as focused professional development or participation in emergency exercises with local emergency managers, or work with other NOAA offices in support of broader NOAA goals.

Second, the NWS must enhance its role as a provider of decision support information for local emergency and elected officials. To accomplish this, the NWS must become more proficient at anticipating the impacts of the meteorological and hydrological conditions that are forecast, and become more knowledgeable in how these partners use the services the NWS provides to make decisions. In addition, the NWS must expand its capabilities to provide hydrometeorological support for other types of hazards such as terrorism, hazardous materials incident response, and other non-traditional events. The NWS will need to further expand the already close working relationships with local emergency managers, elected officials, and other partners to ensure NWS services meet their changing needs. Weather Forecast Offices with cluster support roles and links to external partners (e.g., state and federal agencies, universities, other NOAA organizations) in a variety of areas will be uniquely positioned to lead these efforts.

Third, the NWS must develop a more highly collaborative culture that makes the best use of the expertise that is distributed within the national and regional centers and in local offices. This more collaborative culture will result in forecasts that are more consistent in space and time across WFO boundaries, yet are highly accurate for local customers.

Forecasts which are both highly consistent and accurate across WFO boundaries are crucial to many NWS customers and tools and methods must be developed to achieve both of these results. Developing forecasts that are consistent across areas larger than a

single WFO's area of responsibility among peered WFOs (each with equal weight in the decision process) will require improvements in the nature of the forecast process. The team generally agreed (one dissenting opinion, Appendix D) that developments in four key areas will lead to forecasts and other services that are both accurate and consistent across WFO boundaries. The four areas are:

- Enhanced collaboration tools
- Near real-time performance verification
- A more consistent digital forecast initialization scheme
- Increased accountability for consistency in the forecast process

The development of enhanced forecast collaboration tools will allow forecasters to share information during the forecast development process, identify instances where discrepancies exist, and provide the tools to resolve discrepancies efficiently. The team recommends the use of video teleconferencing with shared graphical display capabilities to allow forecasters to convey reasoning and to make decisions in a timely manner. The use of overlapping forecast domains, where forecast points on both sides of WFO forecast boundaries, are influenced by each offices' thinking, will further encourage collaboration to arrive at a consensus forecast.

The availability of near real-time grid-based performance feedback is crucial to developing collaborated forecasts. NWS must develop a reliable analysis of record to serve as the baseline for this performance feedback. Verification based on the analysis of record should be made available as quickly as possible, which will allow local forecasters to develop further skill in forecasting at the local level.

The availability of improved numerical forecast guidance will contribute to more consistent forecasts through the development of a common initialization scheme. The benefits of a common starting point at the beginning of the forecast process include reducing discrepancies between office boundaries and minimizing the time needed for local forecasters to conduct collaboration. Once the forecast initialization process has completed, forecasters can determine where additional value can be added locally, and also where collaboration is needed across WFO boundaries.

The fourth development needed to ensure the most accurate and consistent forecast is accountability to make consistency a high priority. Forecasters must understand that consistency and accuracy are not opposite ends of the same continuum, and that there is an operational need to produce a forecast that is both accurate locally, and meteorologically consistent across a larger area. Technological advancements will make the development of temporally and spatially consistent forecasts easier, and all managers should be held

accountable for an office's ability to work with surrounding WFOs in this collaborative process.

Technology advancements will be an important component of the 2015 CONOPS Plan, both internally as part of the process of developing services, and in communicating information externally through remote briefings or deployable incident meteorologists. Internally, the team recommends the continued development of expanded-domain grid editing software to allow local offices to easily expand forecast areas when assuming routine duties from a peer WFO, and in the further development of overlapping grid domain software as part of the forecast collaboration process. Additionally, visual display software should be developed for routine use within a cluster to display the status of cluster offices and the reassignment of services during both routine and high-impact operations. Externally, the capability to relay information remotely requires the use of enhanced briefing tools, using a combination of web-based and video-conferencing capabilities. A Technology Scoping Sub-team should be formed to work with OS & T and *ERSL/GSD* (formerly FSL) in order to brainstorm how to design tools for expanded domain capability, collaboration, and other requirements related to the Conops design.

Implementation of the CONOPS Plan will require simultaneous demonstrations of the clustered peer approach in multiple areas of the country. Clusters should be developed within the areas chosen based previously discussed elements. Suggested areas for the demonstrations include a mountainous region in the west, the Great Lakes region, southeast coastal region, and a plains region. Demonstrations across such diverse regions of the country should provide important feedback and lead to refinements in the clustered peer approach.

An implementation team consisting of a variety of representatives should be established to lead the process. The team should consist of representatives from the following components of NWS:

- Demonstration Domain (local offices staff)
- Regional and National Headquarters
- NCEP
- CONOPS Team
- Partners from the regions in which the demonstration is located
- Recognized authority on organizational change in the federal sector

The Implementation Team should define and develop explicit measures of success based on NWS objectives and partner needs. Since both NWS objectives and partner

needs are constantly evolving, the implementation team should have the authority to adjust components of the demonstration and expected outcomes accordingly.

The path to 2015 will require the skills and commitment of all NWS employees. Working together, NWS will build on the credibility it has earned through years of service to the American people, and while capitalizing on continuing advancements in science and technology.

VI. Strategic Outcomes: Evolving into the Future

The completed transition to the new Concept of Operations assumes improvement in forecast model guidance and IT capabilities, and will lead to efficiencies in the production of environmental forecast information, along with the expansion of services with respect to impact analysis and decision assistance tools.

A. Benefits

The CONOPS with offices clustered by partnership opportunities, climatology, and ecosystems provides: increased opportunities to work with and represent NOAA and external partners; efficiencies in the production of environmental information during low impact situations; efficient service backup and load sharing opportunities; increased opportunities for science sharing and research; and effective leveraging of local expertise into the environmental information repository. All operating units will be resourced according to mission requirements. This structure positions resources for adjustment as advancements in science and technology impact the routine production of environmental forecast information, increasing the agency's ability to support advanced decision aids.

The CONOPS presented provides a structure which will keep NWS resources in close proximity to our customers and partners, ensuring that weather and water sensitive decision makers have ready access to high value environmental information. Regardless of where the environmental information is produced, accountability for that information resides with the part of the organization from which the information is delivered. The structure also positions program management closer to the agencies and areas impacted, thereby quickening response to partner requirements. By effectively leveraging expertise across all levels of NWS, local resources will be available to more closely interact with partners and customers to identify, and meet their service requirements. This proximity also offers opportunities to integrate and further the mission of all NOAA line offices.

A shift from phenomena based operations to impact based operations, along with the addition of probabilistic forecast information, will allow NWS personnel to increase service and add value to model guidance, and decrease the amount of resources devoted to forecasting for low impact events. Information will be reliably provided in formats which meet customer needs. This shift will also allow the agency to recognize the unique needs of individual employees and concentrate their efforts to add maximum value.

Effective implementation will be characterized by a reduced number of participants in the production of routine environmental forecast information, with increased resources available for forecast interpretation, impact analysis and on-site decision assistance.

B. Success Measures

During the implementation of the Concept of Operations the agency must track:

- Forecast quality
- The quality of the forecast information must remain constant or improve. Forecast quality will be measured by accuracy of gridded forecasts, meteorological consistency, and timeliness.
- Value added at all stages of the forecast process
- Comparison of the human value added to that of model guidance will be routinely tracked and monitored. Effective return on investment of value added measures will identify if shifts in production responsibility are warranted.
- Identify cost savings (efficiencies)
- Cost management measures will be used to identify effective use of fiscal resources, and identify areas requiring study for further efficiencies.
- Effective measure of partner and customer support and satisfaction
- Standardized customer satisfaction measures will be used to ensure that NWS is effectively meeting partner and customer requirements. Dedicated resources will be identified to complete these measures.

VII. Costs:

- Implementation Team travel and meetings
- Technology Scoping sub-team
- Software/hardware development
- Demonstration related travel, management, and documentation

Appendix A

CONOPS Team Membership

Mike Foster, Chair
MIC, Norman, OK

Bill Bunting, Acting Chair
MIC, Dallas/Fort Worth, TX

Dan Cobb
SOO, Caribou, ME

Kevin Cooley
National Centers for Environmental Prediction

Larry Dunn
MIC, Salt Lake City, UT

Tom Graziano
Acting Chief, Hydrologic Services Division, OCWWS

Don Jiron
NWS Headquarters

Lynn Maximuk
MIC, Pleasant Hill, MO

Andy Nash
NWS Pacific Region, Honolulu, HI

Dan Sobien
NWSEO National Vice President

Appendix B

Operations Concept Philosophy Principles

1. We will ensure weather sensitive decision makers have ready access to high value environmental information.

2. We believe that proximity to our customers and partners is key to achieving and maintaining the quality of our information and services.

3. The credibility of NWS is a primary asset that will be maintained at all costs.

4. The degree of consistency and accuracy of our information corresponds to the value they provide.

5. We will provide information that includes estimates of uncertainty, and is widely recognized as credible and reliable.

6. Enable reliable access to information and services in formats which meet customer needs

7. To greatest extent that resources permit, we will measure the value of the services we provide in support of high-impact events. We acknowledge that not all aspects of the value of high impact services are amenable to objective measurement.

8. We will ensure that all national centers and field offices have the tools and technology necessary to efficiently and effectively produce the digital environmental information repository (one stop shopping portal)

9. We will routinely verify and quality assure the digital environmental information we produce and make these verification data readily available to forecasters and managers to ensure resources are used most efficiently and effectively. The verification system should be tailored to include the information that lets us make resource decisions about services for high-impact events.

10. We will efficiently and fully leverage the investment in numerical forecast guidance and ensure that this guidance is used by field offices.

11. We will facilitate the rapid transfer of new science and quality assured technology into operations.

12. When designing systems, adaptability of technology is a criteria that is as important as initial cost

13. We recognize the unique needs of the individual employee

14. We concentrate the efforts of our people where their expertise and effort allows them to add value.

15. We will dedicate resources to leadership training and succession planning

16. Operating units should be resourced according to mission requirements

17. Maintain a distributed concept of services where local offices are responsible for making resource decisions.

18. Regardless of where the environmental information is produced, accountability resides with the part of the organization from which the information is delivered.

19. Operating units are clustered by partnership opportunities, climatology, and ecosystems

20. National and regional service program leads should be located at operating units in areas where the program is active

Appendix C

Minority on Philosophy Principles number 17 and 19

Prepared by Dan Sobien, NWSEO Vice President

The NWSEO believes that these principles and the implications associated with them will result in the degradation of service that will risk the agency's credibility and put life and property at risk.

Appendix D

Minority opinion on the team vote on the concept that in 2015, NWS makes forecast decisions (current NDFD grids) through collaboration; there is no authority to resolve disputes or impose a decision

Minority Report for NWS CONOPS
Submitted by Kevin Cooley
11/6/2005

Introduction

During the CONOPS team meeting in Arlington, VA in late October, the CONOPS team defined a set of possible options for a CONOPS and established assignments for members of the team to add detail to each option in preparation for a subsequent CONOPS team meeting scheduled to occur in Charleston, SC in early November. Two options of interest to me were "C" and "D." These two options centered around a three tier system of operating units that would collaborate in sequence from most local to national to produce forecast information that was both consistent and accurate. I an explicit element of both options was a collaboration process brokered by a decision making authority at each stage of the process.

I was assigned to provide a write up and modified graphic view of these two options and I worked with Lynn Maximuk and Dan Cobb to develop the narrative and graphic. The specific objective of the narrative was to provide more detail than a graphic could alone provide and to provide a recommendation about whether there is an optimal number of clusters in terms of efficiency and effectiveness in the forecast generation sequence.

During the first day of the CONOPS team meeting in Charleston, the team voted to remove any aspect of explicit decision making authority. I advocated during the debate over this issue that, irregardless of what operating unit or function might serve as a decision making authority for a given type of forecast process, an explicit decision making authority must exist in order to resolve disputes that I believe will from time to time arise during the collaborative process. Acting under his authority as the CONOPS team leader, Mike Foster accepted the vote and acknowledged my minority position. This report is a follow up to this decision and intended to document this position in writing.

Collaboration and Decision Making Authority

The majority of the other team members felt that a collaborative process and explicit decision making authority were incompatible constructs. I dispute this conclusion. I believe that these two constructs are entirely compatible and in fact necessary to achieve decision making in time frames likely required by the forecast process during high impact events and at a level of resource use consistent with a balance between the cost for a given forecast and the value generated by the degree of accuracy and consistency in the forecast. In short these two constructs are required for both effectiveness and efficiency.

A process whereby a group of persons discusses and presents views of a given forecast and honestly attempts to and achieves complete consensus regarding that forecast at a level of consistency and accuracy is an ideal condition that all members of the team agreed was ideal. Better central starting guidance, more effective verification and a more consistent application of performance accountability will tend to aid in the formation of consensus. However, there will be occasions where a group will not be able to achieve absolute consensus; especially under conditions of limited time and the stress of high impact events. The absence of an entity explicitly authorized to make a decision under conditions of deadlock will in my view allow for aspects of the "fundamentally flawed" operations concept to be perpetuated.

Specifically, the inability to resolve deadlock in a timely manner will result in inconsistencies continually existent in national level mosaics when the available time window for the forecast process expires and local forecasts with comparatively incoherent sensible weather information are assembled essentially by default into a mosaic; with attendant damage to the credibility of the NWS from a national and regional perspective. Additionally, the lack of an ability to declare an end game in the form of a decision will cause "the work to fill the available time" instead of the work for the forecast process concluding in the minimal time necessary to achieve the level of consistency and accuracy necessary. Call it "rock painting" or "gold plating bricks," a purely consensus based method will consistently take more time and resources than a method balanced by a goal to achieve consensus with a management trigger to break deadlocks. The lack of an ability to break deadlocks effectively creates the power of full veto for all participants in the process and it is not conducive to sustained efficient and effective decision making in the forecast process. It can be reasonably argued that the knowledge that an empowered decision maker exists will limit posturing that would otherwise remain unchecked.

During the debate over this issue, I questioned the team to relate experience with an organization that efficiently and effectively executed totally consensus based decisions

under mission conditions similar to the NWS; namely being highly time bound and protecting life and property. This question was left unanswered. Quite to the opposite, I provided an example of an organization that routinely makes efficient and effective decisions under highly stressful and time bound conditions; namely decisions made under combat conditions by Marine leaders. I described how Marine leaders routinely solicit input from subordinates concerning how best to accomplish a given mission. Subordinates are accustomed to giving input quickly and succinctly given the realities of the combat environment. Once subordinates have been heard, the leader makes a decision, the debate is over and execution begins. I proposed that the time bounding and stress of combat in which the Marines use this "solicit and decide" approach was akin to the stress and time bounding experienced by NWS forecasters during high impact events.

Subsequent to this example and in part in response to an observation by the team's executive sponsor that the NWS is not the Marine Corps, I related that I could not think of a single example of a private or public sector organization that was both efficient and effective in a public safety oriented service or mission and relied on a purely consensus based model for management decision making. I have nearly 15 years of experience as a leader and a management consultant and I have not observed a single instance of this type of management mechanism being successful even in the medium term. Again, this question of a relevant example the decision making approach codified in the team's opinion and ultimate decision remains unanswered. Ironically, the very decision making mechanism established by the NWS Director for the CONOPS team is the "solicit and decide" method that I advocated.

Forecast Product Type Maturity Cycles

One assumption made by the team during its deliberations concerned the degree to which improvements in common starting guidance, verification, accountability and better collaboration tools would minimize disagreements among participants in the forecast process. These improvements can be termed the "four improvements." The most optimistic manifestation of this assumption is that these factors will combine to such an extent by 2015 that disagreements over the forecast will be effectively eliminated and human interaction with automatically generated sensible weather information will be minimized. While I acknowledged that improvements in these areas will tend to minimize (but not eliminate) disagreements and that without disagreement, the degree of human interaction would be minimized, this optimistic assumption is badly flawed.

The concept of a product type maturity cycle is helpful in revealing this flaw. This maturity cycle concept recognizes that the NWS does now and will continue to produce in 2015 a wide variety of products in a wide variety of disciplines; from QPF, to probability of precipitation, to temperature, the wide speed and direction, to connective potential, to turbulence, to sea surface temperature, the sea state, to cloud cover, to storm landfalls, to tornado outbreaks, to solar radiation and so on. The state of science, human experience and numerical weather prediction capability vary widely across our existing "portfolio" of products/forecast information. Some parts of the portfolio are in the mature part of the cycle and these are the product types that will have disagreement most effectively limited in 2015 by the "four improvements." However, the existence of new and relatively immature product areas will continue in 2015 as the NWS works to satisfy a more broad set of mission requirements integrated with other NOAA partners.

Ecosystems forecasts, air quality forecasts and others that we may not envision today will likely constitute these relatively immature product types in 2015. For immature product types, key parts of the "four improvements" namely the NWP portion of the common starting guidance and the verification capability are likely to not minimize the possibility of disagreement among participants in the forecast process. The inherently uncertain nature of new product types sets the stage for disagreement; and not that born of intransigence but rather that arising from honest and well intentioned debate over difficult decisions.

The optimistic assumption made by members of the CONOPS team that disagreement over the forecast will be effectively eliminated by the "four improvements" requires that one also assume that the NWS product type portfolio will consist of only mature product types in 2015. I dispute this notion of a fully mature product portfolio in 2015 and therefore dispute the assumption that the "four improvements" alone will effectively eliminate disagreement. With disagreements over the content of a forecast still existing in 2015, and the time available to execute the forecast process still as equally limited as it is today, how will the NWS efficiently produce credible, consistent and accurate forecasts across its portfolio? This question remains unanswered.

Implications for the CONOPS Options

Both CONOPS options "C" and "D" where developed with a "solicit and decide" management mechanism and the removal of this mechanism effectively renders both options neutered. The third option seriously deliberated by the CONOPS team was option "E," a two layer management approach using the cluster concept solely as a mechanism to

facilitate load shifting/sharing by local operating units. No substantial forecast process improvements are codified in Option “E” and this option does not address enough of the “fundamental flaws” mentioned in the CONOPS team charter. The level of detail defining option “E” was not sufficient for me to discern how the local and national operating units would collaborate to improve on the forecast consistency portion of the “fundamental flaw.”

The weakness in relying on the “four improvements” absent the “solicit and decide” management approach appears to me to be magnified with option “E.” The number of individual entities involved in collaboration and the timing of the collaboration not being specified, it is not at all clear how option “E” will improve over the status quo in terms of overall forecast quality; especially with regard to balancing consistency and accuracy.