

San Antonio Water System (SAWS) AMI Program

AMI Solution Architecture – Final Draft

August, 2019

Table of Contents

Section	Page
1. Phased Solution Architecture and Roadmap	3
2. Proposed Phased Implementation and Architecture Components	11
3. Proposed High Level Pilot Sprint Schedule	26

1. Phased Solution Architecture and Roadmap

This section of the document describes a phased approach to implementing AMI at an enterprise level within SAWS. This “strategic architectural roadmap” provides specifics on a simple and feasible, building-block approach towards full AMI implementation. Please note that this is an initial, proposed architecture that will be further refined as the program progresses. Additionally, once an AMI/MDMS vendor solution has been finalized, more detailed design sessions around the various architectural components identified will need to be performed.

1.1 Solution Architecture by Phases

The following is a high-level summary of each of the phases:

Phase 1 – Planning and Requirements

The current phase where these initial artifacts are produced from an IT, PMO, and program planning perspective.

Phase 2 – Pilot

This phase focuses on getting up one or two Pilot solutions up and running, balancing two factors – to not have a great disruption on IS and affect IPS production systems, but still have enough functionality to evaluate the pilot results and demonstrate the value of AMI to the enterprise. It is recommended to GPS the Smart Meters at time of installation and continue to perform this throughout program deployment.

Phase 3.1 – Business Release 1

This phase is the start of AMI deployment and focuses on getting all the applications and integration up and running in production mode and emphasizing the full Meter to Cash process. It is highly recommended that SCP be enhanced to support business requirements around customer presentment of the granular consumption data, more customer self-service, personalization, and advanced alerting and customer communications through the outbound communications gateway. It is also recommended to implement a Mobile Workforce Management (MWFM) solution and integrate this to IPS to aid in AMI deployment and accelerate the AMI program benefits.

Phase 3.2 – Business Release 2

The primary focus of this Phase centers around Business Intelligence, namely analytics, dashboards, and reporting from the non-production, MDMS Disaster Recovery instance using a preferred visualization and reporting tool such as Tableau. Another more minor component is to interface MDMS to the EOC Water Outage Map application to aid Operations in visualization of specific MDMS-generated alarm, alerts, and events that would aid in water trouble and leak management operations.

Phase 3.2 – Business Release 3

This Business Release concentrates in efforts on introducing the Conservation Salesforce CRM into the program. Depending on business requirements and functionality desired around customer enrollment and customer program management, integration to the Enhanced SCP would be required, and also potentially to MDMS.

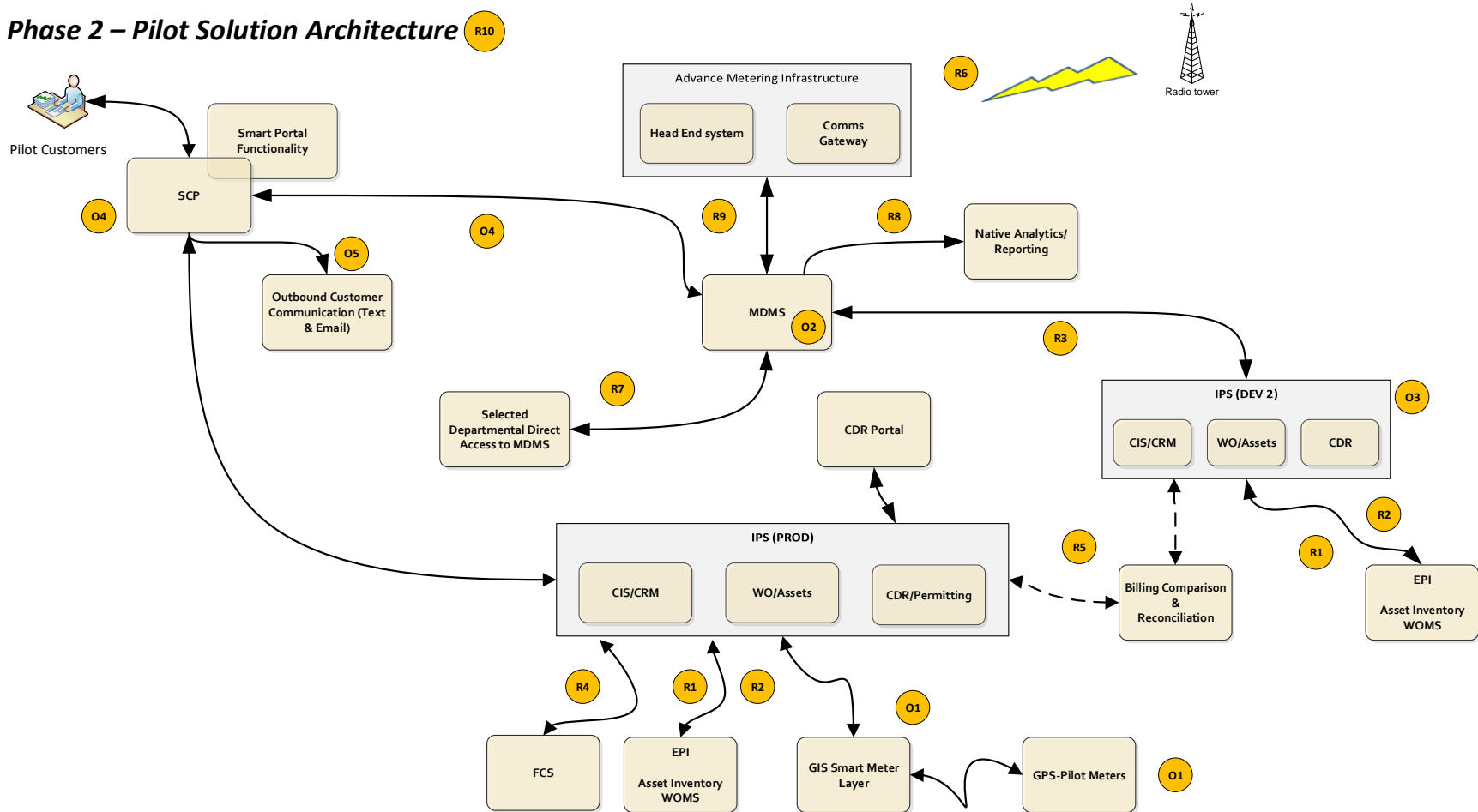
Phase 3.2 – Business Release 4

The major component of this phase is adding IVR for customer self service transactions related to MDMS information (e.g. querying on daily consumption, signing up for specific alerts, etc.) and the necessary integration to the Enhanced SCP, Conservation Salesforce CRM, and IPS. A minor component of this phase is also interfacing the Trimble Fire Hydrant Pressure system to the EOC Water Outage Map, or alternative passing the hydrant pressure through the AMI network and leveraging the MDMS to Water Outage Map integration that was implemented in Business Release 2.

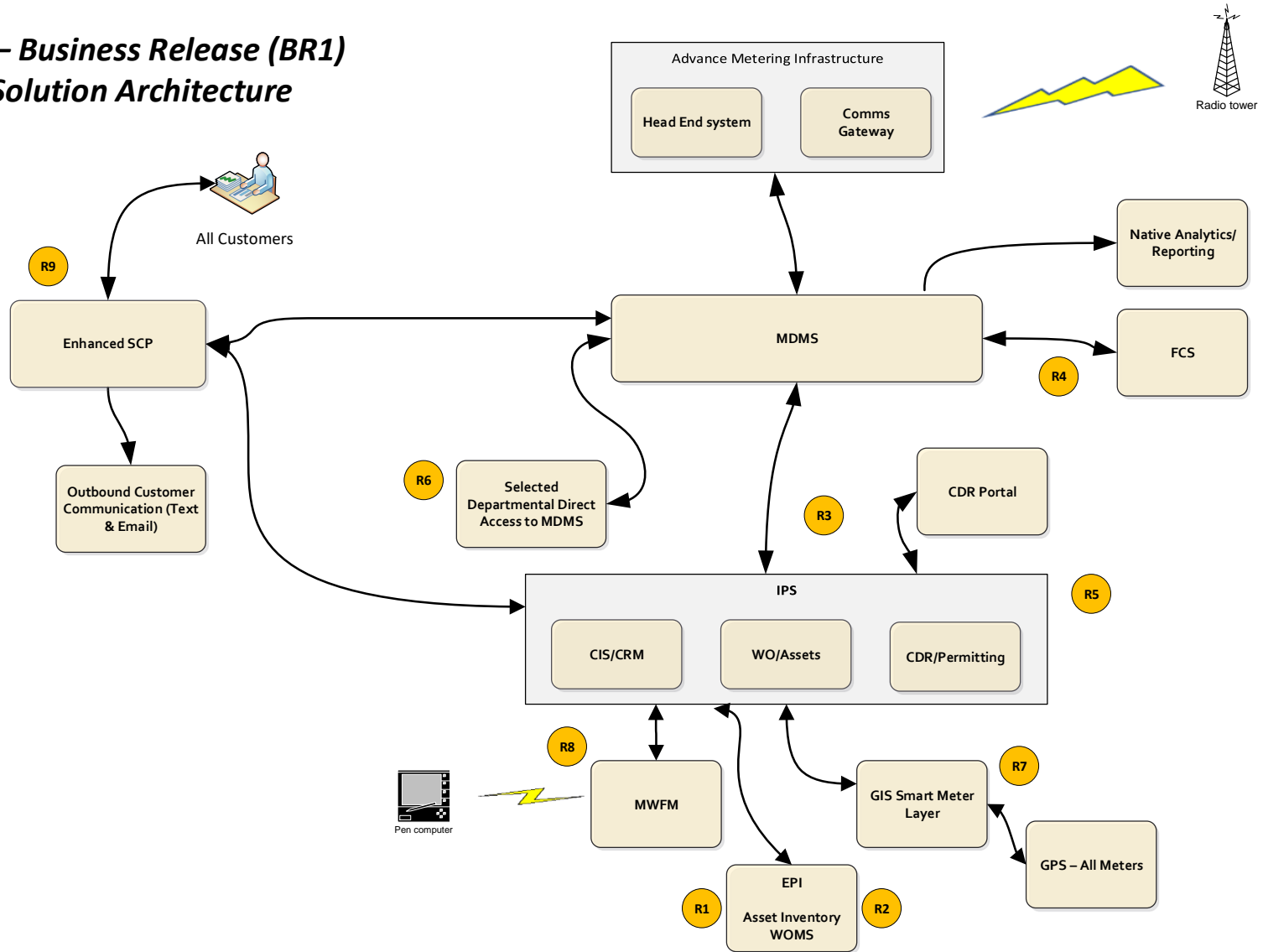
Phase 3.X – Full Deployment

The final phase of the program represents the full deployment of the AMI network and replacement of SAWS meters with Smart Meters. Some other significant initiatives are also recommended – specifically, expanding the Conservation Salesforce CRM to an enterprise CRM, re-architecting the Data Warehouse from an enterprise perspective with a data model, revised schemas, and a standard ETL tool to obtain data from a variety of data sources, including MDMS. As MDMS data storage requirements continue to increase, it is also recommended to implement some Archival/Purge solution to optimize performance and reduce storage costs, while still meeting data retention requirements.

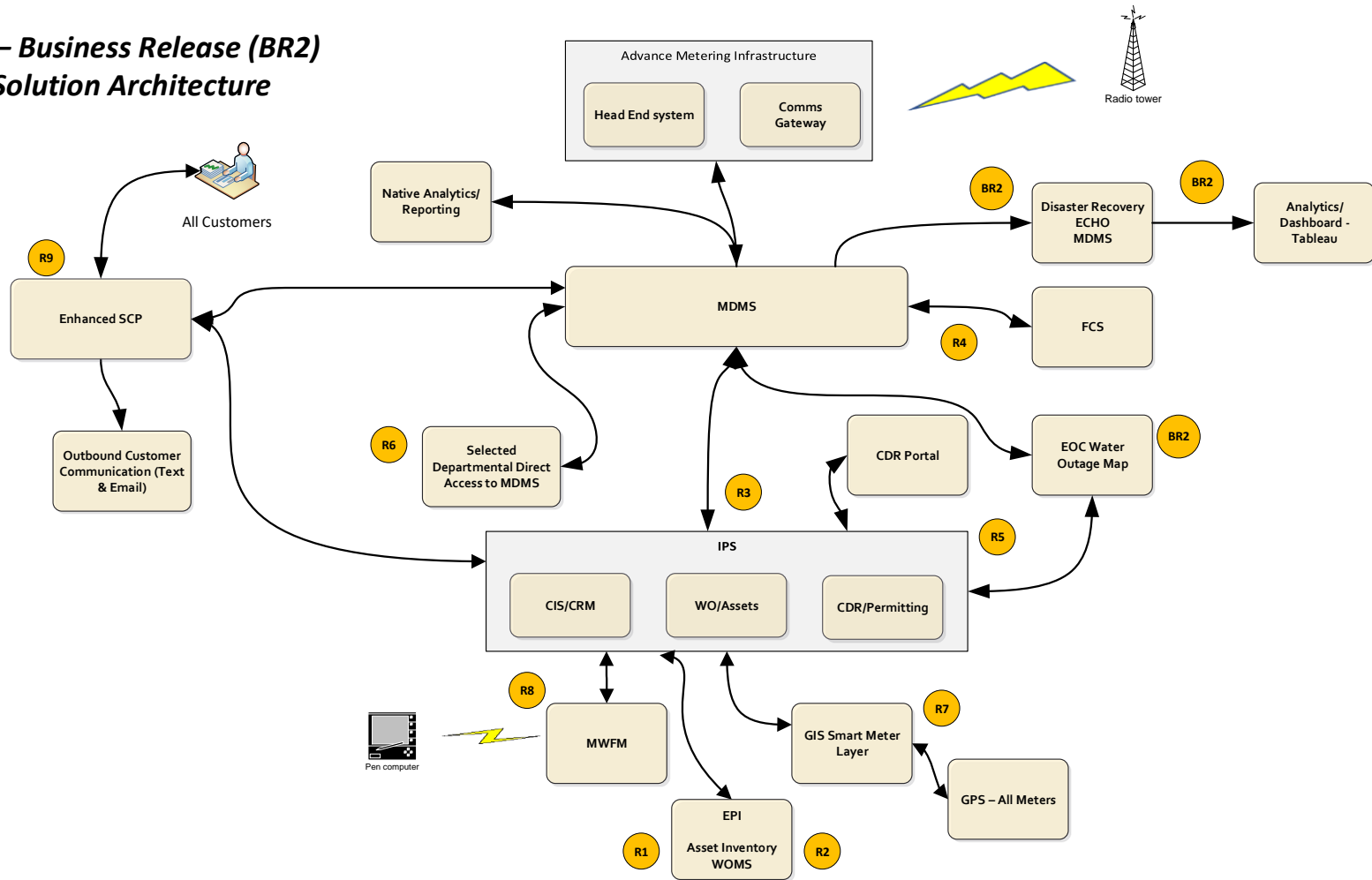
Phase 2 – Pilot Solution Architecture R10



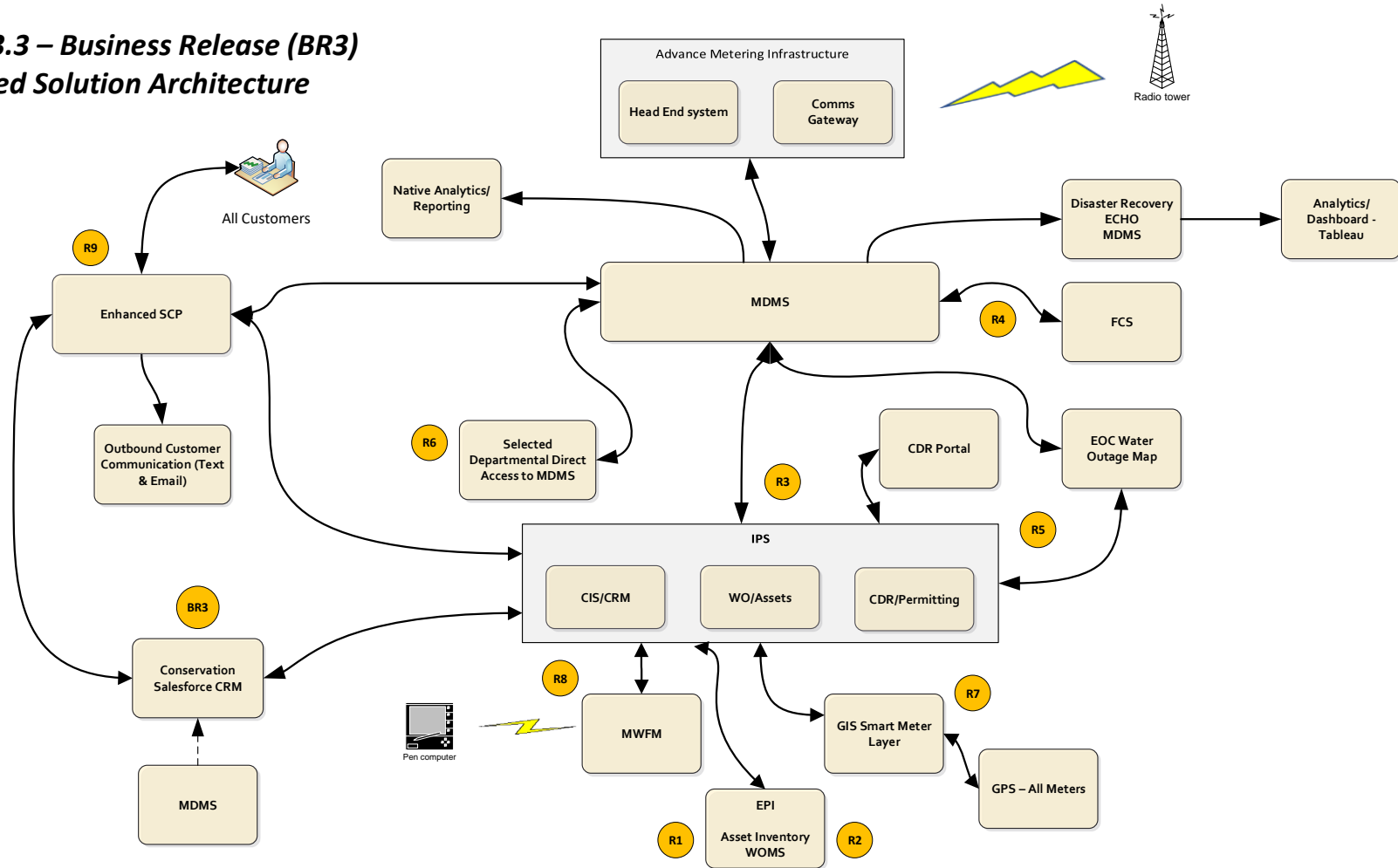
Phase 3.1 – Business Release (BR1)
Proposed Solution Architecture



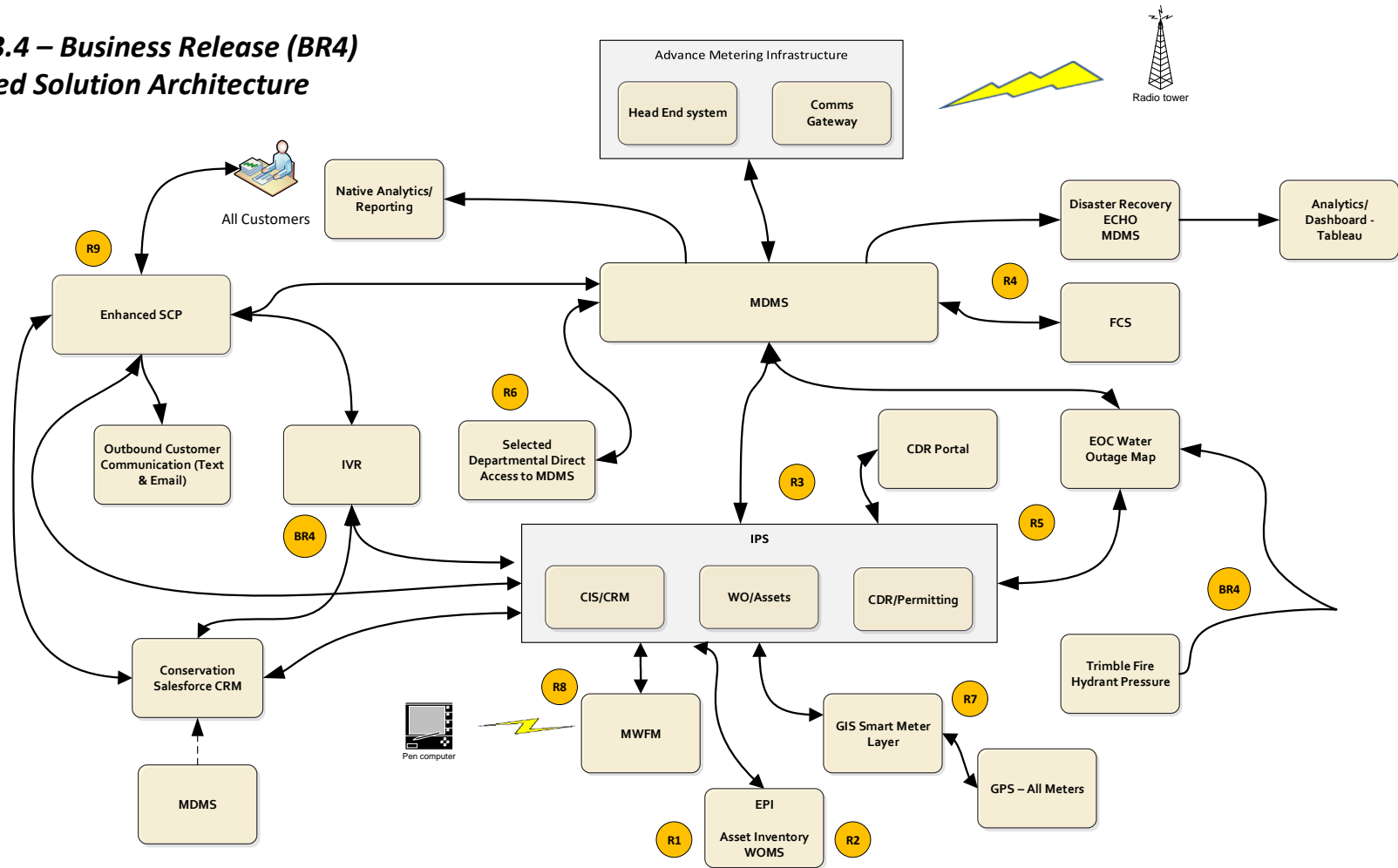
Phase 3.2 – Business Release (BR2)
Proposed Solution Architecture



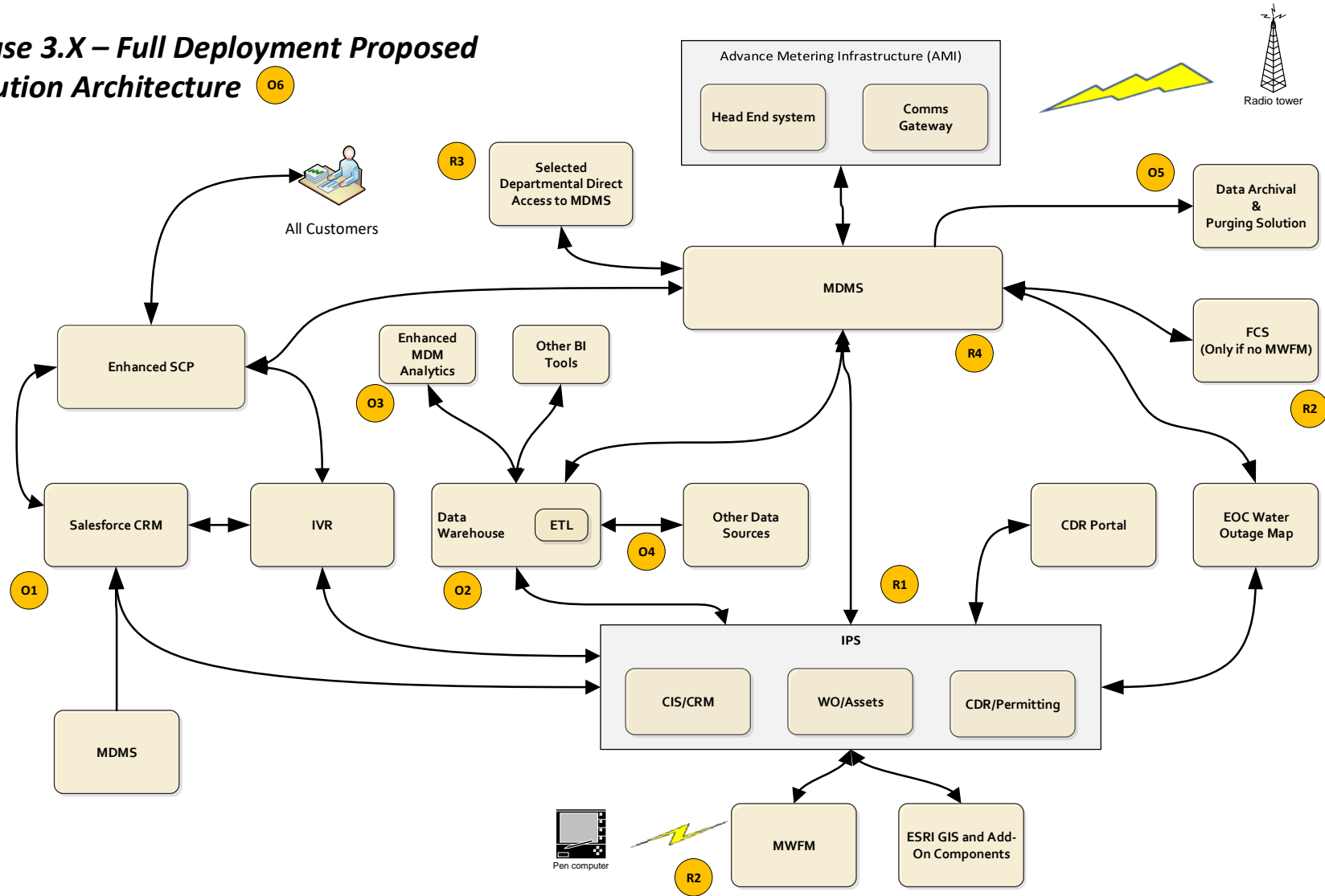
Phase 3.3 – Business Release (BR3)
Proposed Solution Architecture



Phase 3.4 – Business Release (BR4)
Proposed Solution Architecture



Phase 3.X – Full Deployment Proposed Solution Architecture O6



2. Proposed Phased Implementation and Architecture Components

The proposed phased strategy depicted in the previous diagrams slowly builds upon the base functionality in Pilot Phase 2, and gradually builds on this “baseline” approach in an incremental manner with Phase 3 Business Releases 1-4, ending with Full Deployment.

Within each phase, a series of strategic “components” are defined and described in the following tables. The impact of each of the strategic component is assessed in more detail by outlining the business impact or business benefit, describing the IT impact, and then proposing any recommendation, justification, and other considerations for including this component in this Phase. An “R” is used to denote a required component and is referenced in both the diagrams and the tables. An “O” is used to denote an optional component and is referenced in both the diagrams and the tables. “BR” is used to denote the specific business release and is referenced in the diagrams and the tables.

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
Phase 2 - Pilot				
R1	End Point Asset Inventory data uploaded to IPS PROD and DEV	Synchronization between the Supply Chain data in IPS and the vendor	Most likely a manual data dump from EPI vendor during Pilot	Although the number of records uploaded during Pilot is minimal, if an opportunity exists to automate the data upload, it would be beneficial, as it can be applied throughout deployment
R2	End Point Installation data from WOMS uploaded to IPS PROD and DEV	As the EPI installs assets, all the required data is synchronized in IPS	Support the data upload into both PROD and DEV environments	Can look at automating the WOMS upload process into IPS via Web Services or FTP
R3	Integration from MDMS to IPS DEV	Aggregated Monthly Reads sent from AMI MDMS to IPS DEV	MDMS to IPS DEV integration using Web Services/API	Bulk data transfer from MDMS to IPS will most likely be a batch process, but aggregated monthly reads will be real time via Web Services
R4	Continue having FCS feed monthly reads to IPS Production during Pilot Period	Business as normal for SAWS, without significantly affecting billing processing and operations Better understanding of AMI/MDMS impact when performing Bill Comparison and Reconciliation	Minimal, as this integration exists currently	

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
R5	Manual process of both Read and Bill Comparison and Reconciliation during Pilot period	Better understanding of the impact of AMI/MDMS as it relates to billing. Ability to configure various business rules with VEE and then see its impact on the customer bill	Standing up IPS DEV environment and integrating to MDMS Producing “mock bills” from DEV for comparison and reconciliation	If actually producing bills from IPS DEV is too cumbersome, then comparing the aggregate monthly consumption from MDMS to what is produced in IPS PROD may be sufficient
R6	AMI Network Considerations <ul style="list-style-type: none"> • Data Encryption • Security at Backhaul • System and Network Monitoring • DMZ/Firewall 	Minimal, as these considerations are transparent	Various security options need to be evaluated, including any “overhead” that encryption or other processes introduces	Communicate to customers and business areas that the data is secure, possibly encrypted, and protected via a variety of security mechanisms on the AMI Network. Recommend bringing an external resource to perform penetration testing on AMI Infrastructure
R7	Enable very selected Direct Departmental Access to MDMS during Pilot	Allows “superusers” to test MDMS functionality during pilot period, including VEE processing Allows other users in view only mode to see the functionality and data stored in MDMS	Configure read/write access for selected individuals/departments Monitor performance/latency of MDMS during peak access	Negotiate with vendor now on Enterprise site license, especially for read only access. Strongest negotiation position is at start of program.

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
R8	Leverage Native Analytics and Reporting off of MDMS and Head End	Especially in the Pilot stage, the built-in reports and analytics of the AMI systems will give users some business insight into the value of the customer consumption data.	Minimal, as no customization of the reports and analytics engine is required.	Manage expectations around native reports, which may be very limited. Use this opportunity to determine the true analytics and reporting requirements for BR1 and beyond.
R9	AMI Head End to MDMS Integration		Supported by vendor – demarcation point for IS should be MDMS	Depending on vendor solution, this may be direct, or via a comms gateway. Leverage any pre-built integration from MDMS to Head End.
R10	Two or more vendors to evaluate	Ensuring that Pilot customers from 2 vendors are “demographically equivalent”	Need to support double integration in this table to two vendor solutions. Need two instances of IPS DEV	Need to manage added complexity and keeping the pilot areas distinct for comparison
O1	Consider “GPS’ing” all Pilot Meters during pilot meter installation and provisioning and store information in GIS, and potentially pass to IPS		Most likely a manual update of the data versus automated data loading. GPS fields may need to be added to GIS and IPS.	Although listed as optional, strongly recommend using smart meter installations as opportunity to get GPS coordinates Ensure sub-meter accuracy

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
O2	VEE Pre-Processing and testing of business rules for validation and estimation	<p>Allows SAWS to test VEE processing and define the initial business rules for validation and estimation (missing reads)</p> <p>Allows SAWS to “practice” editing of MDMS and any resultant billing adjustments or other downstream processes</p>	Modifications to IPS DEV may be required and then tested extensively to ensure it has not affected other areas.	<p>Although it is recommended to shift VEE pre-processing to MDMS, SAWS does have the option to continue performing these functions in IPS and have MDMS only send the aggregated monthly reads</p> <p>For Pilot, it may be best not to modify IPS DEV and have the extra complexity of removing certain pre-processing routines</p>

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
O3	<p>Expand and test IPS DEV data model to support Smart Meter requirements</p> <ul style="list-style-type: none"> • Firmware Tracking • MIU Characteristics • Meter Attributes • GPS Coordinates • Service Point Interconnection • MDMS Pre-processing and Billing Component 	<p>More extensive meter information in IPS, especially GPS coordinates and Service Point interconnection, may streamline some future business processes</p>	<p>Expanding the data model in IPS to support the required new fields and attributes</p> <p>Enhancing the IPS to GIS integration to support certain data transfers (e.g. GPS)</p>	
O4	<p>Presentment of Customer consumption information, down to the granularity that SAWS decides.</p>	<p>Pilot Customers would be able to visually see their consumption history,</p>	<ol style="list-style-type: none"> 1. Minimize Production impact to IPS 2. Integration of MDMS to either SCP or third-party solution 	<p>Evaluate two options to give pilot customers visual access to their consumption and smart meter data:</p> <ul style="list-style-type: none"> • Build into current SCP • Third Party solutions like Water Smart or Milestone ePortal <p>If third party option selected, recommend integrating into current SCP via iFrame or equivalent technology</p>

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
O5	Smart Portal integration to selected Outbound Customer Communications Gateway	Enables personalization via alerts and notifications that the customer selects based on certain events (e.g. bill produced, unusual high consumption, etc.	Support integration from embedded Smart Portal to selected customer communications gateway	Standardizing on a product solution for all outbound customer communications

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
Phase 3.1 through Phase 3.4 – Business Release (BR1-BR4)				
R1	End Point Asset Inventory data uploaded to IPS	Synchronization between the Supply Chain data in IPS and the vendor	Support the data upload into IPS	Can look at automating the Asset Inventory upload process into IPS
R2	End Point Installation data from WOMS uploaded to IPS	As the EPI installs assets, all the required data is synchronized in IPS	Support the data upload into IPS	Can look at automating the WOMS upload process into IPS via Web Services or FTP
R3	Full Integration between MDMS and IPS PROD	<p>Ability for the business areas to see granular customer consumption data</p> <p>Supports future state business processes</p> <p>Ability to perform “actionable insight” after analyzing data</p>	Clear line of demarcation for support of MDMS, as vendor is responsible for AMI network to MDMS integration	<p>Leverage any standardized product adapters if available</p> <p>Web Services integration is required approach</p> <p>Responsibility for MDMS to AMI Network integration should be implemented and supported by vendor</p>
R4	FCS to MDMS Integration	<p>Continued manual reading as the deployment process continues</p> <p>Supports business scenarios where manual reads and field visits are still required</p>	FCS to IPS PROD may no longer be required, as it is shifted to MDMS via a standard adapter/API	Consolidates all usage data into MDMS

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
R5	Continued modification and enhancements to IPS, related to VEE pre-processing and integration of AMI systems and Enhanced SCP to IPS	Configurable business rules and algorithms with VEE in MDMS Better estimation capability for missing reads and intervals MDMS allows for “initial measurement” before transitioning to “finalized read” state	Removing VEE and other pre-processing functionality in IPS	Although it is recommended to shift VEE pre-processing to MDMS, SAWS does have the option to continue performing these functions in IPS and have MDMS only send the aggregated monthly reads
R6	Continue to provide Direct Departmental access to MDMS (both view only and edit access) for a variety of scenarios. <ul style="list-style-type: none"> On-Demand Reads Provide CSA’s more structured access Other native MDMS functionality Bill/Read Reconciliation Native analytics and reporting 	Supports new business processes more effectively	Minimal, outside of the administrative process of configuring user access and monitoring system performance	Realize that giving users and departments access to MDMS may require a fair amount of training, as the MDMS vendor solutions have varying sophistication of their “user interface”
R7	May need to enhance ESRI GIS to reflect Smart Meter layer <ul style="list-style-type: none"> Meter GPS location Selected meter attributes Service Line Interconnection Point 	GIS users have access to more data on SAWS AMI network and selected meter attributes	Enhancing the GIS to IPS integration	

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
R8	Implement MWFM and integrate to IPS	Automation of Service Requests and Work Orders Allows SR's/WO's generated by CDR Portal to also have field automation	IPS enhancements would be required, including integration to MWFM AMI alarms and events processed by MDMS automatically generate service requests and work orders and sent to IPS	Integrate with AVL already in vehicles for better dispatching Helps automate with meter related field activities and ensures data integrity as deployment continues over 3-year period. Therefore, recommending in 1 st business release, even though added integration to IPS is required. Evaluate INFOR's product solution, and determine best fit, as third-party solutions present another option
R9	Presentment of Customer consumption data and level of functionality in Enhanced Portal <ul style="list-style-type: none"> Usage drill down Personalization/Alerts Consumption "Slider" impact Bill "Projector" Leak "Detector" 	<ol style="list-style-type: none"> Transparency of consumption data More effectiveness in conservation programs Ability to personalize customer experience with alerts and notifications (potential High Bill) Built in Analytics allows SAWS to see if customers are using Smart Portal functionality	Requires development of functionality (or pursuing third party option) and Web Services integration to MDMS	Enhanced SCP may involve a series of incremental functionality via Business Releases If SAWS elects to implement the more advanced customer-facing features (such as consumption "sliders", bill "projection", and leak "detection"), then more time must be allocated to develop and test this functionality

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
BR2	Integration between AMI systems and EOC Water Outage Map application	EOC can visually see appropriate alarms, alerts, and other sensor information on the Water Outage map.	Need to process relevant alarms and alerts from AMI into EOC Water Outage map Need to consider “thresholds” to limit false positives/negatives	Consideration of pressure and leak sensors on SAWS Distribution Network Need to determine if some type of “processing” or transformation needs to be performed on the AMI data before being presented on the Water Outage Map
BR2	Develop Tableau (or other tool) Analytics and Dashboards to address gaps in native analytics/reporting functionality included in AMI/MDMS	<ul style="list-style-type: none"> • Non-Revenue Water Analytics • Conservation Analytics • Consumption Analytics • High Bill/Consumption Analytics • Leak and Pressure Analytics • Other Analytics <p>Eventually may be able to perform ad-hoc analytics by the business</p>	Data analyst support to determine the correct back end schemas from the Data Warehouse to be presented in BI Assist the business with the visualization aspect and how to get to the right data	Development of Tableau Analytics and Dashboards can be spread throughout several Business Releases (BRs) Education on the Data Model to key Tableau front-end “super users”
BR2	Tableau BI direct access to ECHO Disaster Recovery site where data has been replicated (1 day and older data) Or another clone of MDMS Production for reporting purposes	Good performance of developed analytics, dashboards, and reports	Data replication of MDMS to DR Site Bringing up separate MDMS environment at ECHO site	Leverage DR instance of MDMS to develop Analytics and Dashboards, minimizing the impact to IPS PROD Since analytic and reporting requirements may be quite extensive, it may be beneficial to take an “agile-like” approach with incremental releases (e.g. BR2.1, BR2.2, BR2.3 etc.)

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
BR 3	Introduction of Salesforce CRM (Conservation only at this time)	<p>Ability to process “cases” with complex process flows</p> <p>Improved Program Management to help introduce and manage various customer-focused conservation efforts</p>	<p>Integration of Salesforce CRM, Enhanced SCP and IPS via Web Services</p> <p>May require integration between Salesforce CRM to MDMS, depending on functionality desired for future conservation efforts</p>	<p>If integration between SCP and MDMS can be leveraged, then the integration between Salesforce CRM and MDMS would not be required (dashed arrow)</p>
BR 4	Consideration of IVR for self-service related to consumption and usage information from AMI systems	<p>Some customers prefer to perform self service via the Phone versus SCP</p> <p>May help promote special programs, such as conservation and leak detection</p>	<p>Would require configuration and enhancement to IVR, including menu and call flow design</p> <p>Would require integration of IVR to Enhanced SCP and Conservation CRM to provide self-service functionality</p>	<p>Although the current IVR solution in place may not be flexible enough to support these requirements, this BR is far enough in the future that a new IVR may be in production</p>
BR4	Integrate Stand-alone Trimble Fire Hydrant Pressure System with Water Outage Map application to show consolidated pressure data	<p>Consolidated view of MDMS generated alarms and alerts with other pressure data</p>	<p>Web services integration to EOC Water Outage Map</p>	<p>Allows EOC to see more data to aid in leak/trouble operations</p> <p>May want to consider bringing the fire hydrant pressure through the AMI network versus the current configuration. If so, then the integration would not be required as we can leverage the MDMS to Water Outage Map integration from the previous Business Release</p>

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
Phase 3.X – Full Deployment				
R1	Continued modification and enhancements to IPS related to MDMS integration, VEE pre-processing, and enhancements to SCP	Continued fine tuning of VEE will produce more accurate bills and greater confidence in the interval data		
R2	FCS Goes away – replaced by MWFM ?	Addresses scenarios where SAWS may still require a non AMI read as part of some field activity generated by IPS	FCS support no longer required FCS to MDMS integration no longer required Enhancements to IPS to MWFM integration may be required	If MWFM is not implemented in previous BR, then FCS would remain, as well as the integration to MDMS Several alternatives exist – depending on whether we want to consolidate all field generated SR's/WO's in IPS and minimize the number of integrations (e.g. MWFM to MDMS)
R3	Continued enhancements for direct Departmental Access	More structured access to MDMS will allow departments get meaningful insight from the key AMI applications.	Need to consider possible latency issues	
R4	Continued enhancements to VEE processing and business rules	Further refinement and application of business rules will improve the validation and estimation routines with interval consumption reading.		If SAWS elects to perform VEE preprocessing in IPS versus MDMS then this component would not be applicable

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
O1	Enterprise Salesforce CRM integration		CRM to MDMS Integration	Requires a well thought out strategy on how IPS, Enterprise CRM, SCP, and other customer-facing applications are all orchestrated to work with each other, and which is the “owner” for different types of transactions.
O2	Re-architecture of Data Warehouse with Enterprise Data Model/Schema	Supports more complex queries and analytics, giving the business areas more insight that is actionable May impact current reports	Standardize on ETL tool	This is a fairly significant effort and will require an enterprise-wide view of the data architecture. As it may impact current reports and analytics in production, expectations and communications with the business areas will need to be managed
O3	Continued expansion of Tableau Analytics and Dashboards related to MDMS and other relevant data sources (SCADA, GIS, etc.)	1. Non-Revenue Water Analytics 2. Conservation Analytics 3. Consumption Analytics 4. High Bill Analytics 5. Leak and Pressure Analytics 6. Revenue Protection Analytics 7. Other Analytics	Tableau analytics and visualization moved from MDMS at DR ECHO to Enterprise Data Warehouse	Since analytic and reporting requirements may be quite extensive, it may be beneficial to take an “agile-like” approach with incremental releases

REF #	Architecture Component	Business Benefit/Impact	IT Impact	Recommendation/Justification
O4	Feed Data Warehouse with multiple data sources using ETL tool		Data loading for: <ul style="list-style-type: none"> • MDMS • Fire Hydrant Pressure • Salesforce CRM • Water SCADA • MWFM • IPS • GIS • Lawson • Other Systems? 	Standard data model in DW allows for more complex analysis (e.g. taking SCADA info and correlating with AMI data for water distribution analysis and optimization?) MDMS to DW is part of AMI program scope. All other data sources ETL and DW re-architecting is separate initiative
O5	Data Archival/Purge Solution for MDMS	Improved performance for MDMS, but will require some technique to access data beyond the “archival point”	Support integration between MDMS and Archiving solution MDMS may have some pre-built ILM functionality that can be leveraged	Decision on how long to retain data in MDMS before performing archival and purge operations Determine if partitioning and compression will help manage the archival and purge process
O6	Evaluate Bill Redesign at end of Full Deployment?	More granularity of smart meter consumption data on bill More consistency across customer communications channels – SCP, IVR, and physical bill	Modifications to IPS and Bill Print process to support new bill re-design	Evaluate feasibility and appetite toward end of full deployment

3. Proposed High Level Pilot Sprint Schedule

The following is a high-level implementation schedule for the Phase 2 Pilot phase of the AMI Program using a “semi-agile” methodology composed of seven (7) sprint components. Please note that this is a representative example and plan which will have to be refined to a lower level of detail once the pilot business requirements have been finalized and one or more AMI/MDMS vendors solutions chosen.

