WASHINGTON ELECTRIC COOPERATIVE, INC.

CONSTRUCTION WORK PLAN FOR 2019-2022

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Engineer Certification:

I hereby certify that this 2019-2022 Construction Work Plan was prepared by me and that I am a registered Professional Engineer in the State of Vermont #5989.

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Anne R. Crocket 10/24/18

I. EXECUTIVE SUMMARY

Washington Electric Cooperative (WEC) receives financing from the Rural Utilities Service (RUS) for its electrical system improvements. One of the requirements for RUS borrowers is the periodic development of a Construction Work Plan (CWP) in accordance with RUS Bulletin 1724D-101B guidelines. This report fulfills the RUS requirement.

Crocket Engineering, LLC has prepared this work plan, building on other studies that have recently been completed, including the 2014 Load Forecast[1] and 2012-2021 Long Range Plan. In addition, this plan meets the requirements of the Comprehensive Energy Plan 2016 issued by the Vermont Department of Public Service.

This CWP, which spells out a detailed work plan for improving the reliability and efficiency of the electrical distribution facilities, is a management tool and a guide for the following:

- The most practical and economical means of serving future loads while maintaining high quality service to consumers.
- An outline for anticipated system changes in terms of major facilities, demand levels and associated costs.
- An indication of future system costs for financial planning and decision making.

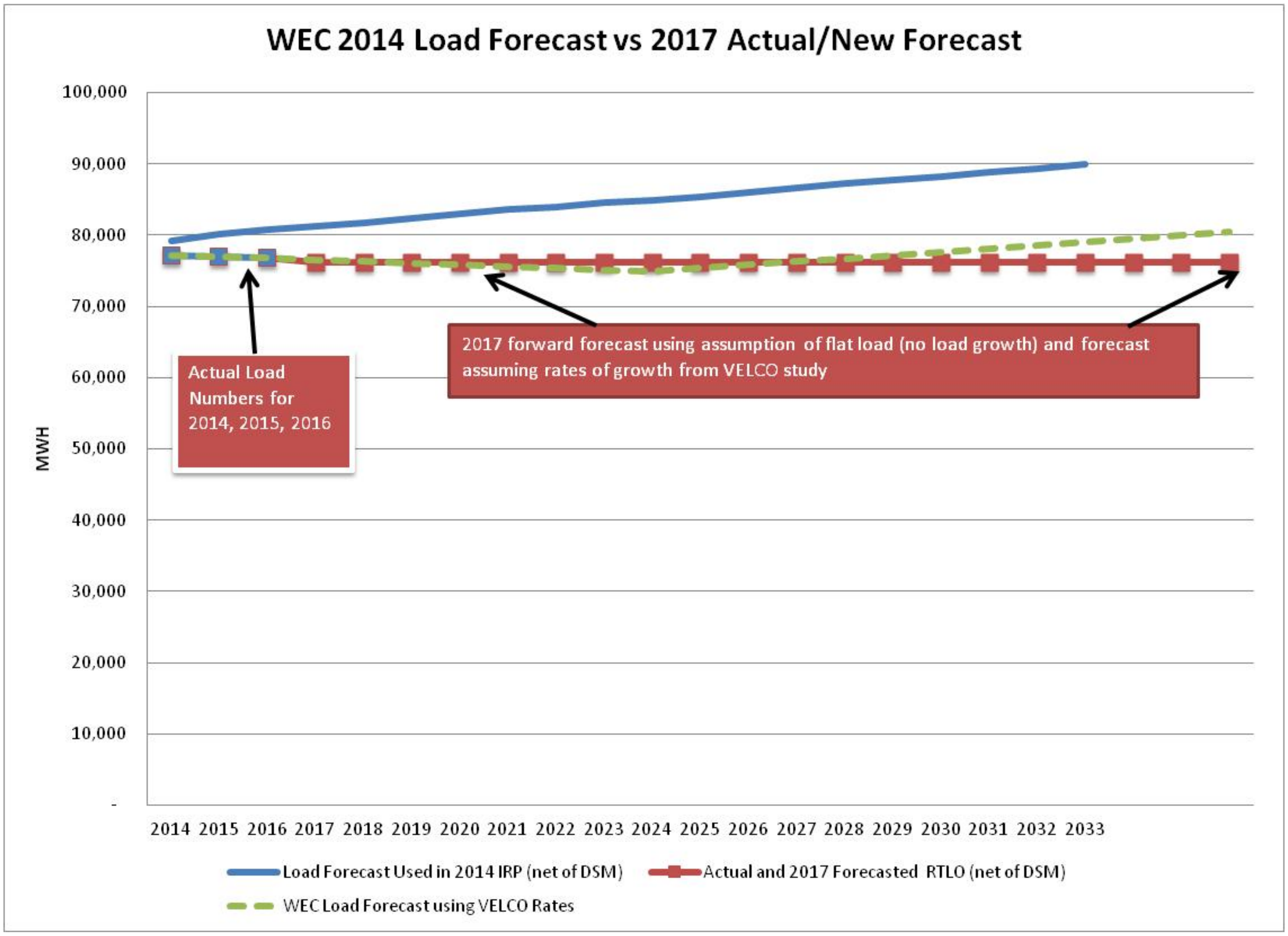
A CWP provides a guide for developing the existing system toward the capacity level which will be required at the end of the planning period, through construction of new facilities and expansion or replacement of existing facilities at appropriate times. The plan incorporates critical elements that need to be addressed to provide safe, reliable and efficient electric service at a reasonable cost.

The analysis for the development of project recommendations for the 2019-2022 CWP is supported by WEC's design criteria, distribution line and equipment costs, past system studies and the review of various historical system data.

The Load Forecast was developed in the Washington Electric Cooperative's 2017 Load Forecast as provided in its updated IRP, and is summarized in Chart 1 and Table 1 below.

[1] WEC is using the 2014 Load Forecast, updated to include 2014-2016 data, as approved in a letter to WEC dated 2/14/17. See Appendix

Chart 1 – Adjusted Coincident Winter Peak Forecast



The following Table 1 shows five years of historical data for WEC's load obligation at the ISO-NE settlement level (inclusive of distribution and transmission losses) energy sales and peak demand that were used in developing the forecasted loads.

Table 1 System Load Data							
	2012	2013	2014	2015	2016	Avg Annual % Increase	Net 4 Yr % Increase
Energy Sales(MWh)	76,506	73,694	75,757	75,620	75,274	0.07%	0.30%
Peak Demand(kW)*	15,373	15,682	16,011	15,914	15,724	0.57%	2.28%
No. of Consumers**	10,660	10,796	10,856	10,936	11,014	0.82%	3.32%
*Coincident Peak demand of all substations **Year end consumers							

The following Table 2 shows five years of forecasted data for energy sales and peak demand that were used in developing the construction work plan.

Table 2 System Load Data								
	Actual	Projected					Avg. Annual % Increase	Net 5 Yr. % Increase
	2016	2017	2018	2019	2020	2021		
Energy Sales (MWh)	75,275	76,222	76,222	76,222	76,222	76,222	0.00%	0.00%
Peak Demand (kW)*	15,724	15,724	15,724	15,724	15,724	15,724	0.00%	0.00%
No. of Consumers**	11,014	11,104	11,195	11,287	11,380	11,473	0.82%	4.17%
*Coincident Peak demand of all substations **Year end consumers								

The recommendations in the proposed CWP are based on the projected load growth and should be adequate to serve loads through 2021. However, WEC will monitor actual load growth at the end of each year to determine if observed patterns warrant changes in project priorities.

The CWP is developed to follow the recommendations and the intent of the 2012-2022 Long Range Plan (LRP) completed in March 2011[2]. Following is a brief explanation of the proposed spending and how it corresponds to the LRP and an explanation of the two spreadsheets attached (2019-2022 CWP Budget Proposal and Project List for the specific projects included in the CWP).

2019-2022 CWP Work Plan Budget (See Table 1 of the Cost Summaries[3])

The spreadsheet provides a cost breakdown for each of the RUS construction categories with a brief description of the major work being done in each area. The budget for several of the categories was developed based on historical data. The table provides the following information:

- 2014-2017 CWP spending approved by RUS in the current work plan.
- The actual expenditures through August 2017.
- CWP projected spending for 2019-2022 by category.

[2] 2012 LRP developed by Crocket Engineering, LLC was utilized for planning purposes and remains a valid plan
[3] See also the RUS Form 740C, included in the cost summaries.

The CWP addresses the major recommendations of the LRP as follows:

Pole Replacement - One of the primary concerns addressed in the LRP was the aging condition of the plant. The pole inspection/treatment program has inspected and treated 100% of the poles. The proposed project list identifies replacing approximately 300 aged poles in the system and 885 of the recommended poles in the specific line reconstruction projects, for a total of 1185 poles. Additional poles will be replaced during the CWP as a result of requests by customers for relocations or requests by cable and telephone companies. These will not necessarily be the system’s oldest poles.

Aged Wire - The plan proposes replacing 47.5 miles of small conductor in the specific projects listed in the CWP. This represents approximately 33% of the small, deteriorated conductor on the system. There will be approximately 108 miles of smaller, aged wire remaining at the end of this work plan.

The Project List, Table 7 of the Cost Summaries, provides detail on each of the proposed reconductoring projects. The list accomplishes one of the goals in the LRP of trying to identify projects that maximize the dollars spent by collectively reducing small conductor, replacing structurally deficient poles and improving reliability.

Substation Work (500) - The 2019-2022 Work Plan does not include replacement of any existing substations. $12,500 was budgeted for miscellaneous equipment replacement.

Other Equipment Additions (600)

- Meters (601) – The plan includes $120,000 for replacement AMI meters and an additional $48,000 for AMI related equipment expenditures.

- Sectionalizing Equipment (603) – The prior work plan completed the AB Chance line cutout replacement program. $8,000 is budgeted for additional transformer cutout replacement. An additional $15,250 was budgeted for reclosers.

- Voltage Regulators (604) – The plan budgets $21,030, for the replacement or addition of two line regulators during the four year plan.

- Capacitor Installation (605) – The plan budgets $9,892 for new capacitors to maintain voltage and reduce line losses.

- Pole Replacements (606) –The plan budgets $450,000 for the replacement of old and condemned poles. The amount will replace approximately 1013 poles.

- Miscellaneous Distribution Replacements (607) - The budget allows $8000,000 for replacement of failed and aged distribution equipment.

- Conductor Replacements (608) -The plan budgets $400,000 for the replacement of small and deteriorated conductors.

- Fault Indicators (610) – The Budget carries over $5,000 of the unspent budget for fault indicators from the 2014-2017 Work Plan.

- Transmission Insulators (1001) – The Budget carries over $110,000 to replace the insulators on the Jackson Corner 34.5 kV line from the 2014-2017 Work Plan.

- Transmission Switches (1002) – The Budget carries over $31,000 of the unspent budget for switches in the 2014-2017 Work Plan.

The 2019-2022 CWP overall spending request is in line with the 2012 LRP and incorporates projects that meet the goals advanced in the LRP.

Table 1, in the Cost Summaries, shows that WEC is requesting $7,778,242 for its 2019-2022 CWP. The funding request is $2,753 higher than the 2014-2017 Work Plan, essentially level funding the plan.

As you will see later in the report in Section IV, WEC completed the majority of the items recommended in the previous work plan. The projects that were not completed have been carried forward into this work plan, with some exceptions.

II. PURPOSE OF THE REPORT

WEC receives financing from the Rural Utilities Service (RUS) for its electrical system improvements. One of the requirements for RUS borrowers is the periodic development of a Construction Work Plan (CWP) in accordance with RUS Bulletin 1724D-101B guidelines. This report fulfills the RUS requirement.

“The Construction Work Plan process is used to determine and document a borrower’s two to four year construction needs that are the most feasible, environmentally acceptable, and economical. New construction is periodically required in order to provide and maintain adequate and reliable electric service to all of a system's new and existing members. The CWP should include all recommended electric plant facilities regardless of the financing source (general funds, RUS, or all other lenders). A CWP is a valuable reference for the preparation of annual construction budgets and schedules. The CWP report is also used as an engineering support document for a loan application to finance a proposed construction program. As such, the CWP is used as a means to inform RUS and receive RUS's approval of proposed new construction items.”[4]

A CWP spells out a detailed work plan for improving the reliability and efficiency of the electrical distribution facilities and is a management tool and a guide for the following:

- The most practical and economical means of serving future loads while maintaining high quality service to consumers.

- An outline for anticipated system changes in terms of major facilities, demand levels and associated costs.

- An indication of future system costs for financial planning and decision making.

A CWP provides a guide for developing the existing system toward the capacity level which will be required at the end of the planning period, through construction of new facilities and expansion or replacement of existing facilities at appropriate times. The plan incorporates critical elements that need to be addressed to provide safe, reliable and efficient electric service at a reasonable cost.

In addition, WEC is required to submit an Integrated Resource Plan every 3 years. This report will address the Transmission and Distribution analysis requirements of the IRP, meeting the requirements listed in Appendix B of the State’s Comprehensive Energy Plan 2016 as follows:

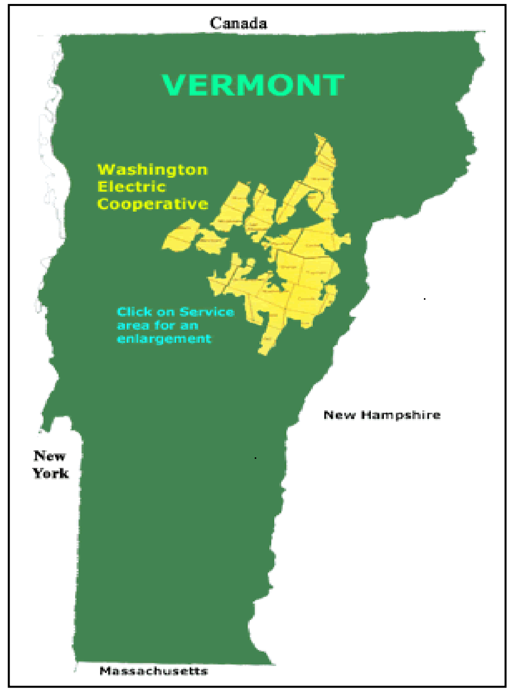
Assessment of the Transmission and Distribution System:

T&D System Evaluation……………………………….see pages 19-20
T&D Equipment Selection and Utilization ………….see page 25
Implementation of T&D Efficiency Improvements….see pages 24-28
Maintenance of T&D System Efficiency…………….see pages 24-28
Other T&D Improvements…………………………….see pages 36-38
Distributed Generation………………………………..see pages 15-19

[4] From RUS Bulletin 1724D-101B, Page 3.

III. WEC BACKGROUND INFORMATION

A. WEC Location and Background Information



Washington Electric Cooperative, Inc. (WEC) is a member owned rural electric company established in 1939. WEC serves over 11,014 meters, 97% of which are residential (including regular and seasonal consumers). The WEC service area covers approximately 2,728 square miles in north-central Vermont including portions of 41 towns in Washington, Orange, Caledonia and Orleans counties. It operates approximately 1,153 miles of distribution line, with eight substations. The balance of customers is a mix of small commercial and larger commercial customers. The largest commercial customer is Harwood Union High School in Duxbury.

WEC is committed to providing its members with safe, reliable, efficient and economical power and periodically prepares a construction work plan to improve the performance of its electrical system. However, there are financial considerations and the WEC Board makes difficult decisions to allocate the limited resources available to the areas that will provide the most benefit for the dollars spent.

B. Distribution Facilities

The existing WEC distribution system has approximately 1,140 miles of overhead distribution line and 13 miles of underground primary distribution, for a total of 1,153 miles. The distribution system operates at 12.47/7.2 kV.

The distribution system consists of eight substations and one primary metering point. Table 3 provides a list of the substations and the approximate length of primary overhead and underground on each.

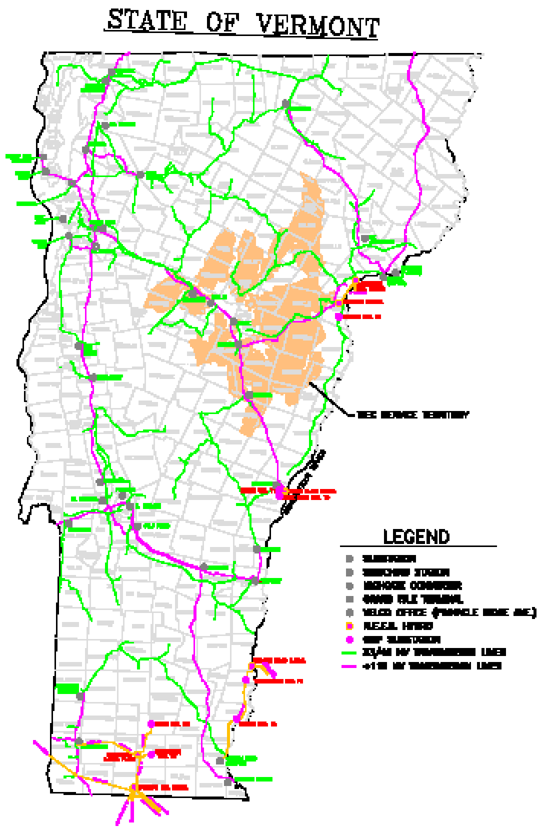
Table 3 Primary Line Lengths by Substation/Feeder					
			Approx. Length (Mi.)		
Substation	Sub No.	Circuit	Overhead	Underground	Meters
East Montpelier	1	1	35.5	0.8	262
		2	73.8	0.9	830
		3	49.7	1.5	582
Jones Brook MP*	2	1	6.9	0.0	79
Mt. Knox	3	1	69.9	0.0	579
		2	133.7	0.6	1,284
West Danville	4	1	38.4	0.5	446
South Walden	5	1	51.3	0.0	427
		2	43.7	0.0	462
		3	36.3	0.1	281
Jackson Corners	8	1	40.4	0.0	409
		2	52.3	0.3	321
		3	107.9	1.3	1,253
Moretown	9	1	42.1	0.3	466
		2	16.3	1.0	154
		3	50.9	1.6	781
Maple Corners	10	1	28.1	0.4	279
		2	49.8	0.1	564
North Tunbridge	11	1	82.4	0.8	687
		2	27.1	0.1	230
		3	34.64	0.0	257
Totals	8	21	1153	10.3	11,014
*metering point only					

The primary conductor size on the system ranges from 3/12 copperweld to 4/0 aluminum on the overhead portion of the line. The primary underground line, which accounts for approximately .9% of the total system, consists of 1/0 Al, 15 kV cable.

Five of the eight substations were originally built as wood pole structures with timber crossarms, varying in age. Four substations, Moretown, South Walden, Maple Corners, and East Montpelier have been completely rebuilt with modern metal frame construction and increased clearances to meet present requirements. West Danville Substation, while a wood pole structure, was rebuilt in 1986 while major equipment was replaced in 2002, and is therefore in good condition.

C. Transmission Facilities

The majority of the power distributed to WEC's customers is generated outside of WEC's service area. Therefore, WEC depends on transmission facilities owned by VELCO and GMP to transmit power to its electrical facilities. The Vermont transmission facilities are shown in the following map of Vermont relative to WEC's service territory.



WEC owns approximately 15.7 miles of 34.5 kV transmission line that completes the link between the transmission facilities owned by others and WEC's substations. These lines interconnect and serve the Jackson Corners, Maple Corners and South Walden substations. WEC owns an additional 2.6 miles of 46 kV transmission line that serves the North Tunbridge substation and 7.2 miles of 48 kV line that connects the Coventry Landfill Gas Plant to the VELCO Irasburg Substation. The specific distances of the transmission line taps are detailed in Table 4.

Table 4
WEC Owned Transmission Lines

Substation	Voltage	Length (Miles)
Jackson Corners	34.5	4.4
Maple Corners	34.5	9.0
North Tunbridge	46.0	2.6
South Walden	34.5	2.3
Coventry	48.0	7.2
Totals		25.5

D. Power Supply

WEC's power supply is comprised of generating resources that are directly interconnected to WEC's distribution facilities and those that are outside of WEC's service territory whose output must be wheeled to WEC over transmission lines owned by others.

There are three significant power resources that interconnect into WEC's electrical facilities. These are the Wrightsville and Moretown Hydro generating facilities and the Williamstown Solar project. The Wrightsville Hydro generating station is owned and operated by WEC and has an output capacity of 933 kVA. The plant is located on the northern edge of the City of Montpelier. The Wrightsville Hydro plant output interconnects to WEC's distribution facilities through Circuit 3 of the East Montpelier Substation.

The Moretown Hydro plant is a 1000 kVA privately owned generating station that interconnects into Circuit 1 of WEC's Moretown Substation. This small power producer primarily generates during the high water periods of the year such as the spring season and other times of heavy precipitation.

The Williamstown Solar project is a 2.2 MW privately owned solar energy plant that interconnects with Circuit 3 of the Jackson Corners Substation. A second large solar project (2.2 MW) came on line on WEC's 48 kV transmission line in Coventry in 2014. Both projects provide power under the state of Vermont's Standard Offer programs. A third large solar project (1.5 MW) is planning to interconnect to WEC's distribution lines at George Road, in Williamstown.

In addition, WEC owns and operates the Coventry Landfill Gas Generating Station in Coventry, Vermont. In 2009 a fifth unit was installed at the plant bringing the total capacity to 8.0 MW. The plant supplies in excess of 60% of the Co-op's annual power requirements.

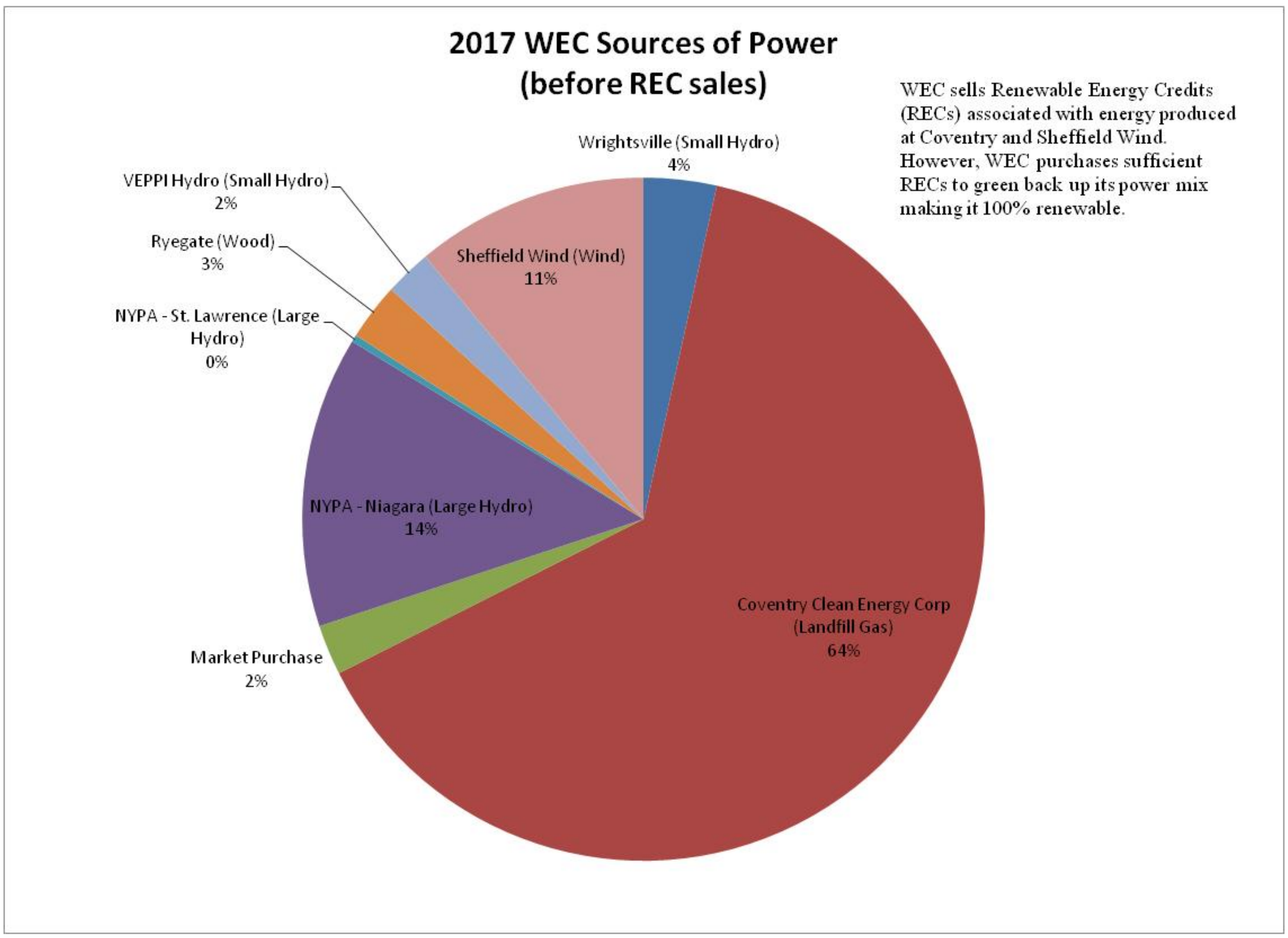
There are also 2,473 kW of small solar arrays (through the net metering program) operated by WEC members and connected to the WEC distribution system. Four additional large solar arrays have applied for interconnection but have not yet been approved: Triland George Street, 1500 kW (Standard Offer), Fairmont Farms, 250 kW (net metering), Fairmont Farms, 150 kW (net metering) and Judgement Ridge Solar, 135 kW (net metering).

From the 2017 WEC Financial Report, the following Table 5 and Chart 2 shows that WEC's current sources of power are renewable and fairly well diversified, reflecting landfill gas, hydroelectric, biomass, wind and system power (primarily natural gas generation). WEC's resource mix is much cleaner than the regional mix as a whole. WEC has made a conscious effort over the years to reduce the use of fossil fuels and nuclear generation, while increasing the use of renewable.

Table 5

2017 WEC Sources of Power before REC Sales & Purchases					
Resources (kWh)	Type	kWh	Percent of RTLO	Percent of Retail Load	Percent of Total Resources
Wrightsville (Small Hydro)	Hydro	2,852,391	4%	4%	3%
Coventry Clean Energy Corp (Landfill Gas)	Landfill Methane	53,075,555	70%	77%	64%
Market Purchase	ISO-NE System Mix	1,968,000	3%	3%	2%
NYPA - Niagara (Large Hydro)	Hydro	11,413,011	15%	17%	14%
NYPA - St. Lawrence (Large Hydro)	Hydro	277,580	0%	0%	0%
Ryegate (Wood)	Wood	2,237,071	3%	3%	3%
VEPPI Hydro (Small Hydro)	Hydro	1,824,077	2%	3%	2%
Sheffield Wind (Wind)	Wind	9,144,771	12%	13%	11%
Total		82,792,456	109%	120%	100%

Chart 2



IV. ANALYSIS OF THE EXISTING SYSTEM

This section of the report contains a description of all of the information that was used to prepare WEC's CWP for 2019-2022. This section includes the design criteria, line and equipment costs, status of 2014-2017 CWP items, analysis of current system studies and historical/projected system data.

The existing system analysis was conducted to determine how well the current facilities are meeting the needs of the system and to identify areas of concern. The analysis looks at the past five years of data covering historical load growth, substation capability, system line losses and reduction techniques, service reliability, vegetation management and overall system performance. In addition, the review examined the age of poles and small/aging conductor.

A. Planning/Design Criteria

Planning criteria are used to establish the rules for assessing WEC's distribution system performance. The criteria include voltage limits, conductor thermal loading limits and equipment thermal loading limits.

The following planning criteria cover WEC's 34.5 kV sub-transmission system and its distribution system that ranges in phase to phase voltage from 12.47 to 34.5 kV. The following planning criteria were utilized in preparing this CWP:

- Distribution lines will be limited to 300 amps or the conductor's normal rating, whichever is lower[5].

- Distribution line voltage will be held between 115 and 125 volts with a maximum swing of 6 volts between peak and off-peak loading. Tap changer compensation will be used where possible to limit daily voltage swings.

- A distribution line will be limited to two levels of line regulation beyond the substation bus.

- Substation transformer and regulator loads will be limited to their nameplate rating.

- The distribution system losses will be evaluated on a regular basis and all cost effective loss reduction projects will be implemented. Re-conductoring, adding phases, adding capacitors, and new metering points and substations are examples of projects to be considered.

- The most important consideration in developing the work plan projects was condition of wires and poles. With the completion of the pole inspection program the lines with a significant number of deteriorated poles have been identified and projects were proposed to replace these lines. In addition, the

[5] 4/0 AAAC has a normal rating of 395 amps, for example.

condition and size of the primary conductor was taken into consideration, with "Amerductor" and Copperweld wire being considered the priority.

B. Cost Estimates

The estimates below reflect the average per mile cost of constructing line based on 2014 – 2017 CWP actual costs. An annual inflation rate was applied to project costs which are reflected in the 2019-2022 Work Plan Budget (Cost Summary Table 1).

Single phase line rebuild, 1/0 AAAC, in place: $98,155/mile
Single phase line rebuild, 1/0 AAAC, relocated: $159,033/mile
Three phase line rebuild, 4/0 AAAC, in place: $162,000/mile
Add a third phase, 4/0 AAAC: $22,000/mile
Add two phase, 1/0 AAAC $55,440/mile
Pole replacement $3900/pole

C. Status of Previous (2014-2017) CWP

A new 2019-2022 CWP is being proposed because the work identified in the 2014-2017 CWP has been nearly completed. A small, select number of relevant projects were carried forward to the new 2019-2022 CWP.

The status of each item contained in the work plan is provided below. Actual data is available through September 1, for each category.

- Category 100 – Service Connections for New Members
  Service connections for new members represented a small percentage of the resources in the 2014-2017 CWP.

- Category 300 – Conversions and Line Changes
  WEC completed approximately 84% of the projects targeted for this category in the previous four-year CWP. A total of 43 projects were identified for upgrading the system in the 2014-2017 CWP, 36 of which were completed or anticipated to be completed. The remaining projects will be carried over to the 2019-2022 Work Plan.

- Category 400– New Substations
  The 2014-2017 CWP did not propose any new substations.

- Category 500 – Substation Rebuilds
  The 2014-2017 CWP did not propose any substation rebuilds.

- Category 500 – Substation Changes
  None of the $12,500 budgeted for Substation Changes in the 2014-2017 CWP was spent, to date.

- Category 600 – Miscellaneous Distribution Equipment

- 601 – Transformers
  The 2014-2017 CWP estimated a total of 1,000 transformers would be required based on historical data. A total of 668 energy efficient transformers were purchased as of July 31, 2017.

- 601 – Meters
  The 2014-2017 CWP estimated a total requirement $101,448 with $50,690 actually spent.

- 602 – Service Improvements
  As of September 1, a total of 15 service upgrades were made compared to the anticipated 60 in the 2014-2017 CWP.

- 603 – Sectionalizing Equipment
  Two new line reclosers were installed under the 2014-2017 CWP.

- 604 – Voltage Regulators
  No new voltage regulators were installed in the 2014-2017 CWP.

- 605 – Capacitors
  No capacitors were installed during the 2014-2017 CWP.

- 606– System Improvement Pole Changes
  A total of 307 poles were changed as part of this category. Of the $1,213,252 budgeted, $1,199,425 was used by the end of July 2017.

- 607 – Miscellaneous Distribution Replacements
  The budget for this category was $600,350 and to date $432,403 of work was completed by the end of July, 2017.

- Category 700 – Other Distribution Items

  - 702 – Security Lights
    A total of 33 security lights were installed as of July, 2017 at a cost of $24,405.

  - 703 – Monitoring Equipment
    None of the $11,505 budgeted for Monitoring Equipment was spent.

D. Distributed Generation and Impacts to the WEC Transmission & Distribution System[6]

From the 2017 IRP:

> Apart from emergency preparedness, utility planning — e.g., integrated resource plans — must consider energy assurance. This includes preparatory actions that help the power stay on, such as careful vegetation management to clear trees away from power lines, and the strategic location of utility infrastructure to avoid

[6] From the 2017 IRP

risks in the first place (for example, siting substations and generators outside of floodplains and river corridors), or to make restoration of power easier (as by siting power lines along roadways).[7]

The pace of innovation in the electric sector is increasing, especially for distributed energy resources. For instance, solar PV prices have fallen by nearly 60% in the last four years, while the number of electric vehicles in Vermont has increased by more than a factor of 10 and cold climate air source heat pumps are rapidly expanding in availability. During the past five years, Vermont utilities have completed deployment of a statewide smart grid, opening the door for modern information technology tools to manage the electric system. Changes brought by evolving technology will challenge long-held paradigms that underpin utility business models, while also providing opportunities for utilities to increase their own fostering of innovation. Vermont must harness this innovation for ratepayers' benefit and use it to help meet our energy goals, thereby advancing economic, environmental, and health priorities.[8]

As noted previously, WEC completed a satisfaction survey of its membership in 2015. Members were asked to rank the importance of various attributes of their electric power and service. Reliability was given the highest importance rating among nine key factors. WEC members ranked reliable service above lower rates and friendly and knowledgeable service. With this directive, WEC seeks to harden its system and decrease the occurrence and duration of power outages. To meet this challenge, WEC seeks to invest in its system as outlined in its CWP. WEC also sees that by responding to changes in industry practices, it will develop tools that will enhance and improve reliable service.

As a result of increased distributed generation, growing deployment of energy efficient technologies, and new plug loads, WEC seeks to explore a T&D system analysis to assess a changing industry. WEC will perform an assessment of its system to explore the impacts of growing distributed generation installed on the grid. WEC's analysis will be done to answer broad overarching questions:

- How much distributed generation can the T&D system accommodate?
- Does it matter by circuit/substation/size where distributed generation is located?
- What are the impacts to WEC's T&D system of new plug load (EVs, cold climate heat pumps, etc)?
- What power quality issues does WEC's T&D system need to address in light of a modernizing grid?
- What data is necessary to conduct a more comprehensive and transparent planning process?

WEC seeks to develop a scoping process that will allow it to specify the tools, process, and protocols to be developed in order to plan and operate a modern grid capable of dynamically managing distribution resources, as well as supporting retail

[7] 2016 CEP p 273
[8] Ibid p 275

markets that coordinate significant distributed generation investment and efficiently manage resources. Engineering and modeling efforts will be used to help convey how WEC plans, operates, and develops its system (where and which types of resources and equipment are best located on WEC's lines). WEC will also seek to balance distributed generation needs and grid modernization with total cost of its system and the impacts to members' rates and bills. In the near term, WEC plans to start a scoping process to outline work it will need to do in the future.

Broader and Long-term Issues:

WEC's operational practices required to operate the grid safely and reliably will continue to evolve based on increasing distributed generation and multi-directional power flows. Operating the distribution system going forward will require a combination of technologies and modernized and improved standards. In the longer term, WEC's plans must incrementally progress from adequately equipping the distribution system with monitoring and communication infrastructure to enabling intelligent, rapid, and precise control.

WEC looks toward deploying automated solutions across the system where it is appropriate and where it offers added value. WEC will focus in the near term on monitoring, observation, and a detailed assessment of its current system and its capabilities as well as its weaknesses. WEC will evaluate the effectiveness of existing systems to determine what modifications may be needed to operate the system safely. It is expected that forecasted distributed generation penetration levels, types, and locations will provide the basis to establish new policies, protocols, and visibility requirements. While WEC's current CWP process encompasses many of the goals noted in the IRP, these are specific items WEC seeks to examine and act on in the upcoming three years:

- Outline and provide an overview of WEC's T&D system;
- Develop and articulate an integrated approach to planning, investment, and operations;
- Develop an open process to promote utility/stakeholder relations, enable third parties the opportunity to provide cost-effective market solutions to identified energy needs, drive member value related to the distribution system, and embrace innovation where cost-effective;
- Specify the expected or potential near-term effects of increased distributed generation penetration on the ability to serve customers, with specific reference to each type of distributed generation and its grid interface;
- Identify the need for system upgrades regardless of distributed generation potential;
- Perform a technical assessment and description of WEC's T&D system with respect to changes from grid modernization (distributed generation, energy efficiency, new plug loads such as EVs and CCHPs);
- Plan for circuit based analysis;
- Identify the level of distributed generation capacity on WEC systems on a given

distribution circuit that could be integrated without additional upgrades or expansions;

- Identify potential system efficiencies (lowering of distribution losses, deferral/avoidance of investments, and rebuild work);
- Develop a plan that will take into account changing load shapes, increased distributed generation, and the effect that these factors will have on the existing system and any planned capital expenditures;
- Identify locations, based on proposed capital plans, where distributed generation has the potential to resolve or mitigate forecasted system requirements that would otherwise necessitate traditional infrastructure investments for system expansion/upgrade and/or maintenance;
- Include effects of storage and behind the meter generation on WEC's system;
- Identify specific system needs allowing stakeholders and market participants to identify opportunities;
- Identify collaboration efforts with other Vermont utilities, VELCO, and the Vermont System Planning Committee (VSPC) process;
- Identify specific areas in WEC's system where there is an impending or foreseeable delivery infrastructure upgrade need;
- Identify specific areas where there is no projected delivery infrastructure need for years to come, and hence the infrastructure avoidance value of distributed generation is likely to be lower or insignificant in the short-term;
- Identify and distinguish operational needs during normal operations and during outage events or other periods of system stress (low voltage condition, near thermal limitations, etc.) and plans to implement reliability enhancing protocols like fault location, isolation, and service restoration;
- Develop information on optimal locations and levels of storage facilities, either on the system or behind the customer's meter, as storage technologies integrated into grid architecture may potentially be used for reliability and to support the deployment of other distributed resources;
- Prepare system data on a substation basis: hourly load curves, voltage, power quality, reliability;
- Prepare individual feeder system data (load data, voltage, power quality, reliability, etc.) for feeders within areas that distributed generation is expected to have more value;
- Consider and propose demonstration projects, as appropriate, in order to continually improve, refine, and otherwise drive toward the state's energy objectives;
- Develop maps and other means to identify geographically where distributed generation is best suited;

- Explore other utility and public sources related to solar mapping and use early research to help guide analysis.

WEC's T&D planning efforts will be an evolving and dynamic process. As we learn more about our system and perform more detailed studies relative to distributed generation and grid modernization, we will adapt our efforts and report findings through the IRP process. Hence, this is an ongoing and iterative process.

E. Analysis of Current System

WEC conducts a comprehensive evaluation of the T&D System every 4 years in conjunction with RUS requirements for a Construction Work Plan. As such, WEC believes no additional studies are necessary at this time but notes a new Long Range Plan is scheduled within the next 4 years. T&D Studies completed since 2000 include:

- EPRO study in 2001 (individual circuit and transformer loading, protection coordination, reliability, losses, and ROW vegetation management)
- Electrical Distribution Study in 2002 done by WEC (optimization study, with load balancing, CVR, and cap placement)
- 2001- 2004 Construction Work Plan including comprehensive system evaluation
- 2004- 2008 Construction Work Plan including comprehensive system evaluation
- 2008- 2011 Construction Work Plan including comprehensive system evaluation
- 2012-2021 Long Range Plan in 2011
- 2011- 2015 Construction Work Plan including comprehensive system evaluation
- 2014- 2017 Construction Work Plan including comprehensive system evaluation
- 2018- 2021 Construction Work Plan including comprehensive system evaluation
- Long Range Plan in 2021

- **East Montpelier #1/Maple Corners #10**

  The East Montpelier #1 and Maple Corners #10 model[9] was run at a 2016 load level of 3,612 kW with base losses of 101 kW. There were no line sections below 116 volts and no single phase lines above 50 amps.

- **Jones Brook #2**

  The Jones Brook Metering Point was run at a 2016 load level of 107 kW. No problems were encountered. The voltage at the line end was 118.5 volts.

- **Mt. Knox #3**

  The Mt. Knox model was run at a 2016 load level of 2531 kW, with losses of 147 kW. The main line voltage before the Route 25 regulators is 114.4 volts on the B phase. To correct this issue, the B phase regulator should be moved to just before

[9] These substations were run together to take into consideration the common metering at East Montpelier and the 34.5kV transmission losses.

Barberry Road. In addition, a new regulator should be installed on Fairground Road. No other issues were found on this substation.

- **West Danville #4**

  The West Danville model was run at a 2016 load of 486 kW. There were no voltage or loading issues in the model. The base line losses were 11 kW.

- **South Walden #5**

  The South Walden model was run at a 2016 load of 1,515 kW, with line losses of 59 kW.

  Feeder #1 is a single phase line that is running 78 amps. A project to extend the three phase line to Noyestar Road will resolve this issue. The 3.1 miles of construction will cost approximately $172,000 and reduce losses on the substation to 48 kW. In addition, the circuit coordination on the line will be improved by allowing a three phase recloser to be used at the substation. This will allow both line and ground fault protection to be used.

- **Jackson Corners #8**

  The Jackson Corners model was run at a 2016 load of 3189 kW with 128 kW in losses, with the Triland Solar facility in Williamstown off. With the solar on, the load is 1146 kW and the losses are 85 kW. An additional 1500 kW of solar is proposed for this substation, pending regulatory approval. No voltage or loading issues were found through the analysis.

- **Moretown #9**

  The Moretown model was run at a 2016 load level of 2,461 kW, with losses of 114 kW. The voltage on Upper Crossett Hill is projected to be below 114 volts. A new regulator, installed on Route 100, north of the three phase construction, will relieve this problem for the foreseeable future.

- **North Tunbridge #11**

  The North Tunbridge model was run at a 2016 load level of 1,505 kW with 76 kW of losses. Feeders #2 and #3 are both single phase lines and running at approximately 55 amps. The lowest expected voltage, after completion of the proposed projects, is 121 volts. Any pole replacements on the main lines of these circuits should take into consideration the long range plan to add phases to these feeders. The voltage regulator on Goose Green Road may need to be relocated closer to the end of the three phase construction to resolve low voltage just in front of the existing location.

F. Current Review Rating Summary (RUS Form 300)

RUS comments from the last review and evaluation of WEC's electrical system and WEC's response (in italics) to each deficiency noted are provided below. The full summary is provided in Appendix A.

WEC complies with the conditions normally needed to justify a rating of 3 in the RUS Bulletin 1730-1, Electric System Operation and Maintenance, for all items that have received a rating of 3 on the RUS Form 300.

The following is a narrative for the items that have received a rating of 2:

WEC's outage statistics received ratings of 2, which continue to be addressed with ROW maintenance, pole replacement and reconductoring.

G. Sectionalizing & Fuse Coordination Studies

WEC has completed the program proposed in the 2001 E/PRO Engineering Study to add tap fuses and re-coordinate the distribution lines. The program has since been expanded to include the replacement of failing porcelain cutouts with polymer based cutouts. From the 2010 Reliability Report: "*The fourth leading cause of outages was the failure of the A.B. Chance line disconnect devices which accounted for 9.5% of the total number of outages and 25.7% of the total customer hours out.*" This project was completed in 2013.

WEC uses three phase electronically controlled reclosers for each substation feeder and has multiple hydraulic line reclosers on its lines, whose placement is based on line length and configuration. Single phase side taps are generally fused. WEC recently installed TripSaver reclosers in place of the hydraulic reclosers on the Middlesex feeder. The range of settings on the TripSavers will allow much closer coordination between the K type fuses and the three phase reclosers. This change will be monitored and, if it proves successful, this strategy will be implemented over the entire WEC system.

H. Historical and Projected System Data

During the course of the various study work completed in 2001, E/PRO examined a wide range of data for WEC's system. The data included load data, circuit loading, transformer loading, reliability data, losses, pole data, vegetation management, conductor data and energy efficiency services. Each of these items is discussed in more detail below.

1. Annual Energy, Load, and Consumer Data

The load growth for this plan was based on the 2017 Load Forecast. The distribution system is modeled using MilSoft Engineering Software and correlates individual consumer load on the system to determine projected feeder load allocation to the system. This information is then modified to reflect the actual peak demands recorded for substations.

2. Substation Transformer and Circuit Loads

Substation Condition WEC recently completed a survey of all its substations. The survey included verifying the make and age of equipment, equipment settings, and inspection of the pole structures. Table 6 provides a summary for the age of the substation, transformers, regulators and reclosers.

Table 6						
Age of Substation Equipment Summary						
Substation	Year Constructed	Year of Transformer Installation	Year of Regulator Installation	Year of Recloser Installation	Year of Construction	Condition of Poles
East Montpelier	2011	2011	2011	2011	2011	Steel
Jackson Corners	1968	1991	2000	2010	1968	Good
		1991	2000	2010		
			2000	2010		
Maple Corners	2006	2006	2006	2006	2006	n/a (steel)
Moretown	2001	2000	2000	2000	2001	n/a (steel)
				2010		
Mt. Knox	1971	1975	2000	2006	1970	Fair/Good
		1975	2000	2006		
		2000	2000			
North Tunbridge	1975	1997	2008	2010	1975	Good
		2003	2008	2010		
		2003	2008	2010		
South Walden	2003	2003	2003	2003	2003	Steel
				2010		
West Danville	1986	2002	2002	2002	1986	Good

Substation Transformer Capacity: The capacity of each substation was reviewed as part of the study. There are no substations that are currently experiencing transformer capacity constraints.

The projected load for each of the substations based on the LRP load forecast is shown in Table 7. The only substation projected to be nearing its transformer capacity is Jackson Corners.

Table 7			
Peak Load Data			
Substation	Substation kVA	2016 Peak Demand	Percent Capacity
East Montpelier*	5000	2512	50%
Jones Brook	n/a	170	n/a
Mt Knox	3750	2523	67%
West Danville	1500	477	32%
South Walden	2500	1500	60%
Jackson Corners	3750	3243	86%
Moretown	3750	2420	65%
Maple Corners*	2500	1100	44%
North Tunbridge	3750	1500	40%
Total System	26500	15445	58%
* The loads are on one metering point			

Voltage Levels and Thermal Overloads: The existing WEC system was modeled in MilSoft Engineering Software at the 2016 load levels to determine if there were any existing deficiencies on the system. The load analysis identified two areas with significant voltage problems which were addressed above. There were not any areas where equipment was near its thermal overload capacity.

Substation Location with Respect to Flood Plains: In 2013, WEC contracted with Dubois and King to complete a study of the location of substations with respect to 100 year flooding. Only WEC's Maple Corner substation falls within the 100 year or 500 year flood plain and when the substation was designed/constructed the equipment was placed on elevated platforms to mitigate flood impact. In addition, the entire load served by the Maple Corners substation can be served by alternate substations that are not located within the 500 year flood plain.

3. Load Current Measurements

The CWP preparation utilized substation billing data. No additional load current measurements were made.

4. Voltage Measurements

With the completion of the AMI metering installation, WEC has the ability to review voltages at every member location. It is anticipated that this information will be incorporated into the planning and operation of the Co-op system as time allows.

5. System Outages and Reliability

The outage statistics over the past three years are summarized in Table 8 below.

Table 8
SAIFI and CAIDI Indices

Category	2012	2013	2014	2015	2016	5 Year Avg.
CAIDI	2.3	2.1	2.1	2.2	2.1	2.16
SAIFI	3.7	3.9	3.2	2.5	3.5	3.36

Pursuant to Public Service Commission Rule 4.900, WEC submits an Annual System Reliability Report to the Commission. The 2016 Report is included in Appendix B. Highlights of the action items presented in the 2016 Report include:

3. **Pole Treatment.** In 2013, United Pole Technologies completed their comprehensive pole inspection and treatment program involving approximately 25,300 poles. To date, approximately 100% of WEC's pole plant has been inspected and treated to help prevent decay. The results of these inspections have been used to assess the current condition of WEC's pole plant, and the treatment of the poles will maximize their life cycle value. The inspection data has been crucial in determining and prioritizing the work projects outlined in the most recent Construction Work Plan.

- **Use of Fault Indicators.** In February 2011 WEC installed approximately 285 strobe type adaptable trip fault indicators on remote sections of three-phase and single-phase feeders, some of which will be replacing older units that were installed in previous years. (Fault indicators are strategically placed to minimize unnecessary patrolling of the line to locate a given fault.) WEC has received ARRA funding to assist in the cost of purchasing and installing approximately 200 of the fault indicators. This has been completed.

- **Vegetation Management Plan.** In 2006, WEC's Board of Directors approved a new and comprehensive Vegetation Management Plan that correlates the management of WEC's ROWs to system reliability and specifically to the worst performing areas. Increased funding has since been made available to provide an enhanced level of right-of-way maintenance. The 2015 transmission and distribution ROW budget amount is $918,000 which is adequate to fund a distribution system trim cycle of just less than 8.5 years and a transmission trim cycle of approximately 7 years. The additional funding provided over the last 2 budget years was mostly allocated to WEC's long, single phase lines located in the worst performing areas of the system. The additional trimming did provide improved reliability to those lines. WEC continues to maintain ROW associated with line reconstruction independently of the budgeted ROW efforts. In 2016, WEC was able to remove over 1200 danger trees and in 2017 will again locate, identify and remove a large number of danger trees that pose a threat to the distribution system. WEC has significantly reduced the amount of "maintenance cutting" of its right-of ways during the winter months in an effort to control sapling regrowth rates. The majority of the maintenance cutting is performed during the summer months while danger trees are removed during the winter months.WEC continues to pursue and investigate the potential expanded use of alternate methods of ROW clearing including excavator mounted Right-of-Way clearing. WEC's Board of Directors continues to work closely with staff to allow for an effective and affordable ROW maintenance program while remaining cognizant of potential rate impact. Adequate and appropriate funding of the ROW program and ultimately the reliability of WEC's electrical system remains a primary objective.

- **Animal Guards.** WEC utilizes wildlife guards in accordance with RUS construction standards and requirements. Wildlife guards are installed on open leads and equipment where wildlife can reach an energized contact point via a grounded contact point such as the lead from the transformer hi-side bushing to the lightning arrester. RUS standards are being evaluated to further reduce wildlife contact by minimizing perch points.

- **Power Supplier.** WEC continues to work with Green Mountain Power, Morrisville Light and Power and Hardwick Electric to secure improvements to the reliability of the 3319, 34.5 kV transmission line which supplies WEC's South Walden substation as well as substations in Hardwick and Morrisville.

6. Demand and Energy Losses

The percentage of energy losses on the WEC system has trended down over the past 10 years. Energy losses are calculated by totaling the amount of energy WEC purchased along with the amount generated by WEC during the year and then subtracting the amount of energy sold to consumers plus the energy used in WEC owned facilities. The difference is assumed to be losses and that amount is divided by the total energy purchased and generated. This provides the energy loss percentage for the year. One of the inherent problems of calculating the losses is that the meter readings recording the consumers' usage do not coincide with the actual dates of purchases and generation. While there is no existing method for measuring the exact losses on WEC's system, this calculation does provide a good annual estimate. Using a consistent formula for calculating energy losses provides a trend line showing the progress of loss reductions.

Historically, in the early 1990's, WEC's system losses were averaging approximately 10.3% per year and continue to improve.

Table 9 System Losses Average 2007-2012							
	Avg. 2005-2010	2011	2012	2013	2014	2015	2016
% Losses	8.2	8.28	7.98	8.35	7.21	7.44	8.09

Substation Transformers

Sixteen of WEC's 22 substation transformers have been replaced since 2000. As part of that process, WEC has worked closely with the Department of Public Service (DPS) to purchase energy efficient transformers for these sites. Each transformer was modeled in the DPS Transformer Loss Evaluation Program to assure that the transformer being considered met the least cost societal test.

Distribution Transformers

Conventional distribution transformers are utilized to step-down primary feeder voltages to customer utilization voltages. Distribution transformers exhibit losses which are proportional to the square of the load being served (load losses) and constant losses in the core steel of the units (no-load or core losses).

In the last decade, manufacturers have developed transformers utilizing low loss amorphous metal and high efficiency silicon steel core transformers that can reduce no-load (core) losses by up to 80% over standard silicon steel core designs of a generation earlier. High efficiency transformers have a higher initial purchase cost than conventional units.

WEC utilizes a competitive bidding process to secure its annual and spot distribution transformer requirements. WEC's purchase process evaluates the life cycle owning cost of a distribution transformer as the initial purchase price plus a cost per watt for core losses and a cost per watt for winding losses. The cost per watt for core losses and coil losses is based on WEC's long term avoided cost for capacity and energy and the anticipated loading cycle over the transformer's life. Transformer manufacturers are provided with these loss penalty factors by WEC which allows them to optimize their transformer designs to achieve a lowest evaluated cost for WEC. This process assures WEC will achieve the most efficient and long term cost transformer. Distribution transformer manufacturers' pricing and policies and WEC 's distribution transformer loss penalty factors are high enough to assure that high efficiency distribution transformers are purchased.

WEC has also worked with the DPS to evaluate the life cycle cost of distribution transformers. WEC had been purchasing amorphous core high efficiency transformers with no load losses considerably lower than the no load losses in standard steel core transformers since 1991. In 2002, the cost of amorphous core transformers increased substantially making the purchase of them not cost effective based on the DPS modeling criteria. Since 2002, WEC has been purchasing silicon steel core transformers which have no load losses lower than the standard steel core transformer. The no load losses in a silicon steel unit range from 10 watts in a 5 kVA unit to 54 watts in 25 kVA unit. In addition to the purchase of new units, WEC also tests the core losses of any transformer removed from the system and it is not reinstalled at another location on the system unless it meets the RUS transformer loss guidelines. Those guidelines establish a level of 33 watts for a 5 kVA unit up to 105 watts for a 25 kVA unit.

The other method of reducing distribution transformer losses is the proper sizing of transformers for the load and minimizing, to the extent possible, the number of transformers installed by utilizing secondary networks to serve multiple residential loads from a single transformer. The Electrical Distribution Study completed in 2002 for WEC addressed the issues of transformer loading and installation of secondary networks. The report included a methodology for properly sizing a transformer for a single customer, as well as a matrix for sizing a transformer for multiple customers with a variety of usage levels. The study also provided charts to be utilized in selecting and installing secondary cable. The charts provide a guide for the size and distance a cable can be installed at various load levels.

With the completion of the AMI program, WEC is collecting more detailed customer load information. When the customer and transformer data bases have been linked the loading profile of each transformer may be reviewed on a periodic basis to assure that overloaded and under loaded transformers are identified. In the interim, WEC continues to review transformer loading when a pole is replaced, installing the correct size transformer for the existing or proposed load. However, with the advent of residential net-metering solar projects, WEC has been increasing the size of transformers to accommodate the generation capacity of many installations. These installations are requiring transformers significantly in excess of the actual customer load.

WEC will continue to utilize both programs to reduce transformer losses on the system.

Conservation Voltage Regulation

Conservation Voltage Regulation (CVR) analysis is normally conducted in accordance with the guidelines provided in the Vermont Twenty Year Electric Plan, dated December 1994 and reiterated in the 2005 Plan[10]. The 1994 Twenty Year Electric Plan describes CVR as an “energy efficiency program applied to an electric utility’s distribution system,

[10] Page A8

involving measures and operating strategies designed to provide electrical service at the lowest practicable voltage level, and in a cost-effective manner, while meeting all applicable voltage standards."

American National Standards Institute (ANSI) requires that under normal operating conditions, the voltage delivered to residential customers, as measured at customers' service entrances, be 120 volts plus or minus 5 percent (114 to 126 volts). This requires 118 volts to be maintained at all points along the distribution feeder, with a service typically experiencing a 4 volt drop from the distribution transformer and service run.

The objective of CVR is to create the flattest voltage profile possible while maintaining 114 volts at the customer's meter. This reduces energy losses on the line while allowing appliances to operate at a higher level of efficiency.

There are two phases of work in a CVR analysis. Phase 1 involves analyzing the existing electrical facilities to examine the voltage drop at various load levels to determine line drop compensation settings for tap changing transformers and voltage regulators. Phase 2 work is evaluating the cost effectiveness of electrical system improvements that reduce the voltage drop along distribution feeders. Feeder improvements include re-conductoring, distribution capacitors, line voltage regulators, voltage conversion, low-loss distribution transformers, etc. All recommended improvements are being addressed in WEC's current or proposed work plan as outlined in the 2019-2022 CWP.

The 2002 Electrical Distribution Study (EDS) completed a system wide CVR analysis and made voltage regulation setting recommendations to enhance system performance and reduce line losses. WEC implemented the recommendations of the 2002 Electrical Distribution Study on all of its substation and distribution regulators and continues to review the regulator settings on a periodic basis. In addition, the use of CVR enhances the ability of a feeder to serve solar projects by reducing the voltage during the day when the solar is on.

Feeder Configuration and Load Balancing

Optimum electrical distribution system performance is achieved when the load is evenly balanced between phases. Balanced loading minimizes losses and maximizes voltage performance for a circuit. It is desired to have no more than a 15% deviation between the load on any single phase and the average current on the three phase conductors. This allows for better ground relay settings and reduced current flow (losses) on the neutral. Achieving a balanced condition at some locations would require the installation of an additional conductor at a significant capital investment, which may not be cost effective.

The 2002 EDS for WEC evaluated the overall balance of the circuits. Utilizing MilSoft Engineering Software, the system was reviewed for load balancing opportunities and recommendations were made that enhanced system performance and reduced losses. This CWP updated the model based on the projected loads and makes additional recommendations.

Electric distribution companies install switches between distribution circuits that allow for load transfer between circuits for back up during emergencies and for planned maintenance of equipment. The system is normally operated with these switches in the open position.

The location of the tie points or normally open points should be examined periodically to determine if they are located in the optimal locations. Load additions or seasonal load changes may require changes in the open switch locations in order to maintain the optimal open point. Future CWP's should examine the need for additional line upgrades to provide for adequate backup redundancy of substation feeders. Substation feeder tie points should be checked for proper sizing.

Capacitor Placement and Power Factor

The installation of capacitor banks on the system is used for power factor correction. The correction of the power factor reduces line losses by providing the reactive component of the load locally, instead of from the generation source, thereby reducing the total current flow on the system. If the installation of the capacitor bank results in excessive leading power factor, there will be an increase in the line losses for the feeder.

The installation of a shunt capacitor bank on the distribution circuit can produce a proportional uniform voltage increase out to the point of application. The capacitor bank helps reduce the peak load voltage drop, particularly in areas where the power factor is lagging. The correct installation of the capacitors can provide for an increase in the efficiency of the distribution feeder by reducing energy losses.

Capacitors can be installed as either constant (fixed) or controlled (switched) banks. Fixed banks are more economical (about 1/3 the initial cost) to install than switched banks. The application of switched capacitors is generally for feeders that have a large ratio between the peak and off-peak KVAR loads in a twenty-four hour period. Fixed capacitor banks require minimal maintenance.

The 2002 EDS recommended the addition of 1900 KVAR of fixed bank capacitors at various locations throughout the system. WEC has completed the installation of these capacitors. The 2019-2022 Work Plan budgets for the addition of 2 capacitors, with the locations not specified.

Strategic Placement of Distributed Generation Facilities

The installation of generation facilities to reduce system line losses was evaluated in the 1995 Long Range Plan update and deemed not to be cost effective at that time. WEC is a signed party to Vermont Public Service Board (PSB) Docket 6290, which is designed to identify constrained distribution areas in Vermont and establish a separate collaborative process known as an Area Specific Collaborative (ASC) to develop the most cost effective solution to the problem. WEC currently has no identified constrained areas and is not participating in any ASC initiative. One of the considerations within the ASC is the use of distributed generation to minimize construction costs and losses on the system.

Since the focus of the CWP is the replacement of deteriorated plant, the installation of large or small scale solar projects will not eliminate nor defer any projects.

A 2100 kW privately owned/funded solar project was constructed in Williamstown. This project required a line upgrade in order to serve it but does not provide any significant system benefits that will defer capacity additions or upgrades.

7. Pole Replacement and Pole Inspection/Treatment

In 2013, United Pole Technologies completed their comprehensive pole inspection.

Table 10 approximates the average age of WEC's poles, and estimates the average age at the end of the 10 year planning period:

Table 10							
WEC Pole Aging Analysis							
					2021		
2017	Poles	Present Age	Weighted		Poles	Age	Weighted
1940's[1]	1225	70	85750		40	75	3000
1950's	1588	60	95280		1588	65	103220
1960's	3389	50	169450		1776	55	97680
1970's	4931	40	197240		4450	45	200250
1980's	2605	30	78150		4102	35	143570
1990's	2823	20	56460		3397	25	84925
2000's	4643	10	46430		4765	15	71475
2010's	3405	5	17025		4616	5	23080
Total	24609		30.3		24734		29.4

This table assumes that the poles in each decade are evenly distributed and thus average to the middle year of the decade. In addition, the table assumes that the proposed reconductoring will replace 885 poles and that 75 poles per year will be replaced for various other reasons.

As shown by the table, with the proposed reconductoring and miscellaneous pole replacement rate, the average age of WEC's poles will drop slightly to 29.4 years. In addition, given the priority of reconductoring, the oldest poles (1940's) on the system should be largely eliminated by the end of the Work Plan.

The planned distribution line rebuilds will replace 70 condemned poles, 578 poles with significant decay and 178 poles with moderate decay.

8. Small/Aging Conductor

WEC has approximately 1,100 miles of primary overhead line on its system. There are several types of conductors currently on the system:

- AAAC--This is an aluminum alloy conductor. WEC uses three sizes of this conductor, 4/0, 1/0 and #2. The conductors are either bare or covered, to reduce tree contacts. This conductor is strong and not prone to corrosion.

- ACSR--This consists of aluminum conductors surrounding a galvanized steel core. The aluminum provides conductivity while the steel provides strength. The galvanized steel will eventually corrode and the wire will become brittle. WEC has not experienced a significant failure rate with its installed ACSR. WEC has 4/0, 2/0, 1/0, #2, #4, and #6 ACSR.

- AWAC--This is similar to ACSR but the steel strands are extruded with an aluminum coating, thicker than galvanization. The steel strands are also not in the center of the conductor, in the type that WEC installed. This conductor is very high strength and was used to allow lines to be reconductored without pole replacements. There are two problems with this type of conductor. First, the nature of the intermixed steel and aluminum strands makes it hard to splice. Second, the use of soft aluminum conductors results in single strands burning off due to tree contacts. The burned strand will then often start to unravel and when the tail is long enough, it may contact the neutral wire causing an outage. These tails can be very hard to locate. WEC historically installed #4 AWAC.

- Hard drawn copper--This consists of single or multiple strands of copper in many sizes. WEC has only #4 installed. While it is old, this wire stands up well to aging and is not in dire need of replacement.

- Copperweld is a three-strand wire made from extruding steel and copper wire together. It is very high strength but relatively low in conductivity, due to the small amount of copper. WEC has this wire in a three-strand version that uses #12 wires. Structurally this wire is still in good shape but the lack of conductivity results in significant voltage drop.

- Copperweld-copper--This is a three-strand wire with one copperweld wire and two pure copper wires. WEC has it in a #6 size. In general, this wire is in good shape but similar to the 3/12 copperweld wire, it lacks sufficient capacity for the present load levels.

- Steel--WEC has .9 miles of galvanized steel wire. While originally very high strength, the galvanized coating has disappeared and the steel is corroding. In addition, the lack of conductivity makes the losses and voltage drop relatively high.

- Amerductor--This wire consists of a galvanized steel strand with two copper wires. WEC has this wire in #8 and #6 sizes. The galvanized coating of the steel has disappeared and the steel and copper are forming a galvanic cell, eating away the steel. This makes the wire very brittle and subject to failure in cold weather due to increased tension.

As noted in the above descriptions, some of the conductors have deteriorated to a point where they fail on a regular basis when making contact with a tree. While all conductors may fail when contacting a tree, small deteriorated conductors will fail more easily. In all cases, the fuse protecting the line will blow, deenergizing the line alleviating any concern for public safety. The overall quality of power delivered to the members is affected in two ways: there is an outage as a result of the wire breaking and there is often a momentary interruption as the circuit breaker tries to isolate the problem. So, while some members see a sustained outage, others see a momentary interruption. While the Co-op has removed a significant amount of these wires from the system over the last 3 work plans, there remains 145.3 miles on the system. Table 11 lists the miles of the remaining small conductors and prioritizes the conductors based on structural integrity and loss savings. It also shows the declining miles of wire as the lines are reconductored through the planning period. A total of 37.2 miles of small conductor is scheduled for removal during the CWP planning period.

As shown in Table 11, 6/8 SCG (Amerductor), has the highest priority, based on its condition, and will be essentially eliminated by the end of 2021. The 3/12 CWC (Copperweld) is the next priority and with the 85.2 remaining miles of it, will take up the remainder of the budgeted funds. At the end of 2021, there will be approximately 60 miles of 3/12 CWC left and a total of 108 miles of all small conductors.

In addition to the structural issues with the small wires, there are loss and voltage problems. The high resistance of these wires results in higher losses and greater voltage drops than for the 1/0 AAAC wire that will be used to replace these wires. For example, 80 kW of load on a ten mile section of 1/0 AAAC produces 1 kW of losses and a 0.4% volt drop. The same 80 kW on a ten mile section of 6A copperweld wire produces 3 kW of losses and a 4.1% volt drop. While the loss savings will not entirely pay for the replacement of the conductors, the offset losses will contribute to the overall efficiency of the system.

Table 11

Conductor	2004	2017	Work	2021	Resistance	Losses
Size/Type	Totals	Totals	Plan	Totals	ohms/1000 ft	Versus 1/0 AAAC**
#3/12 CWC	100.9	85.2	24.9	60.4	8.69	45
#8A CWC	13.3	9.8	9.8	0.0	3.82	20
#8 SCG	5.5	0.0	0.0	0.0	3.82	20
#8A SCG	1.1	0.0	0.0	0.0	3.82	20
#6A CWC	6.7	1.4	0.0	1.4	2.4	12
#6/8 CWC	33.9	27.0	0.0	27.0	2.4	12
#6/#8 SCG	5.5	0.1	0.0	0.1	2.4	12
#6 SCG	16.0	1.5	0.8	0.7	2.4	12
#6 Steel	5.6	0.6	0.0	0.6	17.7	91
#4 AWAC	10.1	17.0	0.4	16.6	2.7	14
#6 ACSR*		2.9	1.29	1.6	0.806	4
Totals	198.5	145.3	37.2	108.2		

*#6 ACSR not formerly shown
**.195 ohms/1000 ft for 1/0 AAAC

9. Vegetation Management

Historically, the WEC mission was to provide power to rural consumers and farmers, and much of the earlier construction took the shortest route possible, which meant off road construction. While the majority of the service territory is still rural, the nature of the service has changed. WEC's consumers have increased expectations of power reliability and quality. Cross-country lines are more difficult to access and costly to maintain.

The WEC Board of Directors approved a new Vegetation Management Plan in 2006 and budgeted $508,000 for right-of-way management in 2007. In 2018, the right-of-way (ROW) budget is $765,624. As shown in Table 12 below, the Board is currently budgeting to improve the trimming cycle for WEC's distribution system. Since 70 – 90% of all outages are tree related in any given year, improved service reliability can be most directly impacted by reducing the number of tree related incidents. WEC does not utilize herbicides as part of its ROW management program. Therefore, flat cutting of the ROW beneath the line is essential to vegetation management and ROW access. The removal of danger trees within and outside the established ROW is paramount in the prevention of tree related outages. Therefore, WEC patrols the transmission and three phase distribution lines in both the fall and spring, identifying potential danger trees that are subsequently removed. Danger trees located on single-phase distribution lines are removed as part of the ROW maintenance program (flat cutting).

Table 12
VEGETATION MANAGEMENT

	Total Miles		Miles Needing Trimming		Trimming Cycle	
Transmission	26		16		7 Years	
Distribution	1,262		882		10 Years	
	2011	2012	2013	2014	2015	2016
Amount Budgeted	$711,967	$726,207	$751,625	$863,444	$805,689	$918,451
Amount Spent	$718,076	$726,968	$748,975	$731,551	$825,843	$892,534
Miles Trimmed	92	95	88	77	78	89

The projected ROW clearing budget for the next three years is shown in Table 13 below. Note that Miles Maintained are equal to the miles trimmed times 1.28 to account for spans that are free of trees. In addition, these numbers do not account for clearing done to facilitate line reconstruction.

Table 12a Projected ROW Clearing				
Year	ROW Budget	Miles Trimmed	Miles Maintained	Danger Trees Removed
2018	$765,624	84	108	1280
2019	$839,627	101	130	241
2020	$856,420	107	137	209

WEC has been relocating cross country lines to roadways as part of its strategy to improve system reliability and reduce vegetation management costs. In addition, the on-going reconstruction of lines will reduce the effects of tree related outages by replacing brittle wire and deteriorated poles. The instances of broken poles and wires due to trees will be cut back to only those instances where very large trees fall on the line. This will not cut back the number of tree outages but will significantly improve the time needed to restore service. The 2018 budget for vegetation management is $765,624.

10. Environmentally Sensitive Areas

WEC has developed a policy to balance the operational needs of the company, including such things as containing maintenance costs, improving reliability and reducing restoration time, with the environmental and aesthetic impacts of line construction.

The policy establishes guidelines for evaluating aesthetics and environmental concerns in the engineering design phase for each line relocation or new line construction. It also promotes underground primary lines as an alternative to overhead construction in cases where the aesthetics or environmental impacts of the project would be significant.

In addition, WEC will be filing a Borrower's Environmental Report with the Rural Utilities Service. This report is required of RUS borrowers to comply with federal environmental standards and is roughly equivalent to an environmental impact statement required of federal projects.

11. Energy Efficiency Services

WEC has historically maintained a strong demand side management plan, investing more than $4 million during the 1990's and being recognized for its achievements by the Department of Public Service (DPS). Co-op members are eligible for efficiency services funded by their Energy Efficiency Charge (EEC) through the Statewide Efficiency Utility. Members are eligible for Co-op energy services as well. WEC provides retrofit efficiency services for all eligible members and acts as a subcontractor to Efficiency Vermont to deliver the Vermont Energy Star Homes program to WEC members.

12. Other Operational Issues

<u>National Joint Utility Notification System (NJUNS)</u>

WEC strives to minimize the environmental and aesthetic impact of its Transmission and Distribution system. WEC uses the National Joint Utility Notification System to track, notify other utilities and coordinate the transfer of utility attachments. The system allows each participating utility a real-time status of current requests, which helps minimize the existence of dual poles and facilities that are in need of transferring.

<u>Underground Facilities Damage Prevention</u>

WEC owns and maintains approximately 22 miles of primary underground distribution lines throughout its service territory. WEC recognizes the potential hazards of dig-ins occurring and has in place a Damage Prevention Plan designed to minimize that risk. WEC's Damage Prevention Plan piggy-backs the National 1-800 DIGSAFE system of notification. Notifications of excavation are emailed from DIGSAFE directly to members of WEC's Damage Prevention Team. The location of the proposed excavation is identified on WEC's system maps and checked against the location of WEC's underground lines. If WEC has facilities in the immediate area the lines are identified and marked in conjunction with DIGSAFE requirements and procedures. If WEC does not have any WEC owned underground facilities in the proposed excavation area then DIGSAFE and the proposed excavating contractor are notified accordingly. WEC marks only WEC owned facilities. If a request involves digging in a location where a WEC member owns and maintains their underground secondary service and WEC is aware of the presence of the underground line, WEC informs the requesting party of the presence of the member-owned service wire.

Storm and Emergency Response

Washington Electric Cooperative's (WEC) primary mission is to provide safe, reliable and economical electric service to the member/owners it serves in 41 towns in the counties of Washington, Orange, Caledonia and Orleans. Events occasionally occur that affect the power distribution system and require WEC personnel to coordinate a comprehensive collaborative effort to restore power in the most safe and effective manner possible.

As part of the RUS requirements for borrowers and in accordance with RUS Bulletin 1730-1 WEC maintains an up to date Emergency Restoration Plan that details appropriate steps and procedures to be followed power to the T&D System in the event of wide spread and catastrophic events. The Plan includes a list of current Mutual Aid resources, resource contacts, and key suppliers, local, state officials including Town Clerks, Road Foreman, Town Emergency Disaster Coordinator and Cooperative Mutual Aid resources nation-wide. The plan also establishes inventory stock levels for critical items and provides a recovery plan in the event WEC's main headquarters is neutralized. The plan established the Operational response that includes a detail of what each position within WEC will do in the event of a widespread outage event. The Plan defines the role off the line crews, the Field Assessment Technicians, the MSRs, administrative and logistical staff as well as the System Dispatchers and the Storm Coordinators. The Plan is all inclusive, reviewed and approved by RUS and updated annually.

In regards to notification of outages WEC, sends out Emails to members where such contact information is available for most non emergency planned outage of less than 4 days notice. Where advance notice can occur, WEC sends out Phone calls, Emails, and Post-cards to members effected by the outage.

During widespread outages WEC update Vtoutages.com every 2 hours or less depending on the restoration progress. WEC maintains its own Website and outage page which reflects real-time outages occurring on WEC's system. At this time it is cost prohibitive to have custom software created so that WEC's Outage Management System writes directly to Vtoutages.com. Member feedback indicates WEC members utilize the WEC OMS Web page for information pertaining to outage restoration updates. However, WEC will continue to update the Vtoutages.com site as requested during widespread outage events. WEC will continue to investigate options to have our OMS system communicate directly with the Vtoutages.com site.

I. Coventry Landfill Gas to Energy Project Pipe Upgrade

Washington Electric Cooperative Inc. owns and operates an 8 megawatt Landfill Gas to Energy Plant located at the Coventry Landfill in Coventry, Vermont. The plant was built and went on line in 2005 with 3 CAT 3520 engine-generator units. Over the years, as the landfill has expanded and more gas has come available, WEC added 2 additional generating units bringing the total to 5. The landfill is now producing enough gas to allow all 5 engine-generators to operate at maximum output. However, undersized gas header pipe located between the main knockout tank (moisture removal tank) and the gas header pipe within the plant is causing a restriction in the form of excessive vacuum drop. This vacuum drop is adding significantly to the plant's parasitic load and preventing the plant blower system from applying additional vacuum to the landfill site's well-field. Additional details and information follow.

The availability and volume of landfill gas at the NEWSVT landfill site has been steadily increasing over the past year as waste input increases and Casella expands the gas collection system. This trend is expected to continue as Casella looks to obtain approval for the addition of the Phase VI landfill. The Coventry LFGTE Plant gas recovery equipment utilizes 4 blower units that apply necessary vacuum to the landfill to extract the gas. The 4 units (75hp each) are nearing their maximum capacity and on recent occasions were unable to recover sufficient gas to avoid odor problems at the site without being supplemented by NEWSVT's flaring system blowers. **A critical reason the LFGTE Plant blowers are near capacity is the excessive vacuum needed at full flow to overcome losses(associated with small diameter pipe, 90 degree elbows etc) between the main header inlet to the gas conditioning system and the landfill.** Vacuum measurements indicate head losses of 25 to 30-inches of water column (w.c.) have occurred between the plant knockout (KO) filter tank and the well-field delivery point, with the engines fully loaded. Approximately 20% of this loss is through the KO filter tank, 50% of the loss is through the large moisture knockout (KO) tank and short run of pipe just outside the plant with the remainder occurring between the large moisture KO and the edge of the well field and the well-field collection system.

The existing KO filter vessel (just inside the plant) was originally designed for 3 engines and currently causing a 5 to 6 inch vacuum drop and is connected to a 14 inch header pipe (adds 12 to 15 inches of vacuum-drop) leading back to the large in-ground moisture removal tank which adds an additional 8 to 10 inches of vacuum drop to the system. The pipe is currently HDPE (High Density Poly-Ethylene) and is buried below ground. The proposed plan utilizes 24 inch

Stainless Steel pipe (currently comparable to HDPE in cost and less problematic for above ground installations). The proposed pipe upgrades and refit of the KO filter vessel will result in a 50% or better reduction in vacuum drop. Reducing these head losses would reduce parasitic electrical load, apply much needed vacuum at the far end of the landfill, improve methane quality and free up blower capacity for future increased LFG flows.

A quote for fabrication and supply of the proposed Phase 1 LFG collection and condensate management system improvements as shown on the SHA drawings using 304SS materials was prepared by Cross Machine, Inc. of Berlin, NH on June 26, 2018. The quote excluded installation, insulation, heat tracing and jacketing. The quote amount was just under $121,000. The estimated cost for installation of the stainless steel pipe and fittings is $42,000 for a total estimated installed cost of $163,000. However, the quote from Cross Machine excluded the 4 – 24" gate valves which have an estimated cost of $42,500 each or $130,000 for all four valves increasing the total project cost estimate to $293,000. A 20% contingency factor is recommended increasing the total estimated installed cost with contingency to $351,600.
As a comparison, a quote was also received by NEWSVT for the furnishing and installation of the proposed Phase 1 LFG and condensate management system improvements using HDPE materials for a total of $171,000 excluding the 4 – 24" gate valves. The 4 gate valves have an estimated installed cost of $130,000 totaling $301,000, including the gate valves.

V. RECOMMENDED PROJECTS

A. Summary

This section of the report summarizes the recommended projects that are included in this 2019-2022 CWP. The projects are separated by substation in this section. Projects are listed in categories that include system improvements, capacitor installations, equipment additions/replacements and system reliability. The overall budget for 2019-2022 is provided in Section VI. See the attached map (Appendix F) for project locations.

B. Projects Listed by Substation

East Montpelier #1

Project Description	Miles	Cost	Phases
301-37 Reconductor #3/12 CWC to 1/0 AAAC	0.93	$91,463	1
301-38 Reconductor #3/12 CWC to 1/0 AAAC	1.81	$177,386	1
301-39 Reconductor #3/12 CWC to 1/0 AAAC	0.78	$124,185	1
301-40 Reconductor #3/12 CWC to 1/0 AAAC	1.15	$112,748	1
301-41 Reconductor #3/12 CWC to 1/0 AAAC	0.58	$56,737	1
301-42 Reconductor #3/12 CWC to 1/0 AAAC	0.60	$58,744	1
301-43 Reconductor #3/12 CWC to 1/0 AAAC	1.20	$117,638	1

Overall, 7.05 miles of line will be rehabilitated at an estimated cost of $738,901.

Jones Brook Metering Point #2

Project Description	Miles	Cost	Phases
302-01 Reconductor #4 ACSR to 1/0 AAAC	0.87	$85,179	1

Mt. Knox #3

Project Description	Miles	Cost	Phases
303-42 Reconductor #6 ACSR to 1/0 AAAC	0.73	$72,092	1
303-43 Reconductor #6 SCG to 1/0 AAAC	0.19	$18,776	1
303-44 Reconductor #6 ACSR to 1/0 AAAC	0.38	$37,254	1
303-45 Reconductor #4 AWAC to 1/0 AAAC	0.43	$41,828	1
303-46 Reconductor #4 ACSR to 1/0 AAAC	0.43	$40,898	1

Overall, 2.16 miles of line will be rehabilitated at an estimated cost of $210,848.

Project 604 will install a regulator on Route 100, north of where the three phase line ends to improve the voltage on Crossett Hill Road. The estimated cost is $10,000.

Under Code 500 a new airbreak switch is planned for the substation. The estimated cost is $12,500.

West Danville #4

Project Description	Miles	Cost	Phases
304-18 Reconductor #3/12 CWLD to 1/0 AAAC	1.03	$100,665	1
334-19 Reconductor #4 ACSR to 1/0 AAAC	0.10	$9,574	1

Overall, 1.13 miles of line will be rehabilitated at an estimated cost of $110,239.

South Walden #5

Project Description	Miles	Cost	Phases
305-34 Add two 1/0 AAAC Phases	1.09	$60,459	3
305-35 Add two 1/0 AAAC Phases	0.96	$53,078	3
305-36 Add two 1/0 AAAC Phases	1.06	$58,548	3
305-37 Reconductor #8 CWC to 1/0 AAAC	1.67	$163,815	1
305-38 Reconductor #8 CWC to 1/0 AAAC	1.03	$101,223	1
305-39 Reconductor #8 CWC to 1/0 AAAC	0.26	$25,561	1
305-40 Reconductor #3/12 CWC to 1/0 AAAC	0.36	$35,786	1
305-41 Reconductor #6 SCG to 1/0 AAAC	0.10	$10,225	1
305-42 Reconductor #3/12 CWC to 1/0 AAAC	0.16	$15,616	1
305-43 Reconductor #3/12 CWC to 1/0 AAAC	0.19	$18,218	1
305-44 Reconductor #3/12 CWC to 1/0 AAAC	0.76	$74,732	1
305-45 Reconductor #3/12 CWC to 1/0 AAAC	0.71	$69,527	1
305-46 Reconductor #3/12 CWC to 1/0 AAAC	0.64	$62,462	1

Overall, 8.98 miles of line will be rehabilitated at an estimated cost of $749,250.

Jackson Corners #8

Project Description	Miles	Cost	Phases
308-53 Reconductor #8 CWC to 1/0 AAAC	1.90	$320,399	1
308-54 Reconductor #3/12 CWC to 1/0 AAAC	0.26	$ 25,375	1
308-55 Reconductor #4 ACSR to CWC to 1/0 AAAC	0.57	$56,160	1
308-56 Reconductor #8 CWC to 1/0 AAAC	0.85	$143,980	1
308-57 Reconductor #3/12 CWC to 1/0 AAAC	0.47	$46,010	1
308-58 Reconductor #3/12 CWC to 1/0 AAAC	0.57	$56,235	1
308-59 Reconductor #3/12 CWC to 1/0 AAAC	0.83	$81,796	1
308-60 Reconductor #8 CWC to 1/0 AAAC	1.15	$112,470	1
308-61 Reconductor #3/12 CWC to 1/0 AAAC	0.68	$66,459	1
308-62 Reconductor #3/12 CWC to 1/0 AAAC	0.31	$30,674	1
308-63 Reconductor #3/12 CWC to 1/0 AAAC	0.78	$76,684	1
308-64 Reconductor #3/12 CWC to 1/0 AAAC	0.42	$40,898	1
308-65 Reconductor #3/12 CWC to 1/0 AAAC	0.68	$66,459	1
308-66 Reconductor #3/12 CWC to 1/0 AAAC	1.01	$99,364	1
308-67 Reconductor #3/12 CWC to 1/0 AAAC	0.38	$37,273	1
308-68 Reconductor #4 ACSR/#8 CWC to 1/0 AAAC	0.85	$143,980	1
308-69 Reconductor #4 ACSR/#8 CWC to 1/0 AAAC	1.25	$210,297	1
308-70 Reconductor #4 ACSR/#8 CWC to 1/0 AAAC	0.64	$108,824	1

Overall, 13.6 miles of line will be rehabilitated at an estimated cost of $1,723,337.

Project 1001 is carried over from the 2014-17 Work Plan and will replace porcelain insulators on the Graniteville-Jackson Corners 34.5 kV line. The estimated cost is $110,000.

Moretown #9

Project Description	Miles	Cost	Phases
309-19 Reconductor #3/12 CWC to 1/0 AAAC	1.04	$102,245	1
309-20 Reconductor #3/12 CWC to 1/0 AAAC	0.52	$51,123	1
309-21 Reconductor #3/12 CWC to 1/0 AAAC	0.47	$46,010	1
309-22 Reconductor #4 ACSR to 1/0 AAAC	0.52	$51,123	1

Overall, 2.6 miles of line will be rehabilitated at an estimated cost of $250,501.

Project 604 will install a regulator on Fairground Road, north of where the three phase line ends, to improve the voltage on Crossett Hill Road. The estimated cost is $10,000.

Maple Corners #10

Project Description	Miles	Cost	Phases
310-36 Reconductor #3/12 CWC to 1/0 AAAC	0.97	$94,809	1

North Tunbridge #11

Project Description	Miles	Cost	Phases
311-43 Reconductor #4 ACSR with 1/0 AAAC	0.30	$29,632	1
311-44 Reconductor #3/12 CWC to 1/0 AAAC	0.87	$85,607	1
311-45 Reconductor #3/12 CWC to 1/0 AAAC	0.53	$51,866	1
311-46 Reconductor #6 ACSR with 1/0 AAAC	0.17	$16,824	1
311-47 Reconductor 1/0 URD	0.42	$67,290	1
311-48 Reconductor #3/12 CWC with 1/0 AAAC	0.57	$56,235	1
311-49 Reconductor #3/12 CWC with 1/0 AAAC	0.54	$53,353	1
311-50 Reconductor #3/12 CWC to 1/0 AAAC	1.17	$92,912	1
311-51 Reconductor #8 SCG with 1/0 AAAC	0.52	$41,353	1
311-52 Reconductor #3/12 CWC to 1/0 AAAC	0.82	$80,402	1
311-53 Reconductor #8 CWC with 1/0 AAAC	1.48	$145,188	1
311-54 Reconductor #8 CWC with 1/0 AAAC	1.57	$154,576	1
311-55 Reconductor #3/12 CWC with 1/0 AAAC	0.94	$92,541	1
311-56 Reconductor #4 ACSR with 1/0 AAAC	0.64	$62,741	1
311-57 Reconductor #4 ACSR with 1/0 AAAC	0.27	$26,937	1
311-58 Reconductor #3/12 CWC with 1/0 AAAC	0.83	$81,703	1
311-59 Reconductor #3/12 CWC with 1/0 AAAC	0.94	$92,021	1

Overall, 12.58 miles of line will be rehabilitated at an estimated cost of $1,231,181.

Other

610	Install fault indicators	$ 5,000
1002	Replace transmission switches	$31,000

Smart Grid Projects

601 AMI Meters system-wide as needed $120,000
601 AMI Repeaters PLC signal repeaters………………… $ 48,000

Generation Projects

1203 Coventry Landfill Gas to Energy Plant, up grade pipes $ 351,600

Cost Summary--Table 1

2019- 2022 Work Plan Budget

	2014-2017 Work Plan		2019-2022 Proposed Budget				
RUS Category	Budget	Actual Completed/WIP*	2019	2020	2021	2022	Total
100 Line ext (OH and URD)	$715,948	$1,166,922	$174,689	$178,183	$181,747	$185,382	$720,001
200 Tie Lines	$0	$0	$0		$0	$0	$0
300 Line Conversions (projects)	$4,021,061	$2,230,877	$1,260,248	$1,285,453	$1,311,162	$1,337,385	$5,194,249
400 New Substations	$0	$0	$0	$0	$0	$0	$0
500 Substation Equipment(Carry-over)	$12,500	$0	$12,500	$0	$0	$0	$12,500
600			$0	$0	$0	$0	$0
601 Transformers	$654,738	$565,774	$101,009	$103,029	$105,089	$107,191	$416,318
601 Meters	$101,448	$103,835	$29,115	$29,697	$30,291	$30,897	$120,000
601 AMI Equipment	$72,377	$0	$11,646	$11,879	$12,116	$12,359	$48,000
602 Misc. Ser Improvements	$20,081	$5,190	$5,338	$5,444	$5,553	$5,664	$22,000
603 Transformer Cutouts	$116,041	$56,378	$1,941	$1,980	$2,019	$2,060	$8,000
603 Line Reclosers	$0	$0	$3,700	$3,774	$3,850	$3,926	$15,250
604 Voltage Regulators	$39,745	$19,341	$5,102	$5,204	$5,309	$5,415	$21,030
605 Capacitors	$10,041	$1,469	$2,400	$2,448	$2,497	$2,547	$9,892
606-Misc Pole Replacement	$610,391	$1,612,538	$109,181	$111,365	$113,592	$115,864	$450,001
607-Misc Dist. Replacement	$1,213,252	$432,403	$194,099	$197,981	$201,941	$205,980	$800,002
608 Misc Conductor Replacement			$97,050	$98,991	$100,970	$102,990	$400,001
610 Fault Indicators	$11,505	$0	$1,213	$1,237	$1,262	$1,287	$5,000
700			$0	$0	$0	$0	$0
702 Security/Street Lighting	$20,081	$23,857	$3,639	$3,712	$3,786	$3,862	$15,000
1001 Insulators-JC line (Carry-over)	$110,000	$0	$110,000	$0	$0	$0	$110,000
1002 Transmission Switches	$31,000	$0	$0	$18,500	$12,500	$0	$31,000
1203 Conventry Pipe Upgrade	$0	$0	$351,600	$0	$0	$0	$351,600
1600 Not Budgeted For	$0	$628,625	$0	$0	$0	$0	$0
Permanent Disc		$0	$0	$0	$0	$0	$0
CIAOC Contribution In Aid of Const	$614,077	$293,791	-$146,781	-$151,184	-$155,720	-$160,392	-$620,000
	$8,374,286	$7,141,000	$2,327,690	$1,907,694	$1,937,966	$1,962,418	$8,129,843

*through October 2017

NEW LINE EXTENSIONS (CODE 100)

SERVICE EXTENSIONS FOR NEW MEMBERS	2014-2017	2019	2020	2021	2022	TOTAL
1. Number of New Members Connected						
a. Overhead--Code 102	253	63	63	63	63	253
b. Underground--Code 101	25	6	6	6	7	25
Total	278	69	69	69	70	278
2. Average Length per Build						
a. Overhead	188	188.3	188.3	188.3	188.3	9 miles
b. Underground	603	602.8	602.8	602.8	602.8	2.84 miles
3. Average Cost per Build						
a. Overhead	$3,723	$2,297.45	$2,297.45	$2,297.45	$2,297.45	$581,254
b. Underground	$8,995	$5,550	$5,550	$5,550	$5,550	$138,747.71
4. Cost of New Members						
a. Overhead	$942,078	$145,313	$145,313	$145,313	$145,313	$581,253.69
b. Underground	$224,878	$34,687	$34,687	$34,687	$34,687	$138,747.71
Total	$1,166,956	$174,689	$178,183	$181,747	$185,382	$720,001
5. Net Cost of New Members to WEC (after C.I.A.C.)						
a. Overhead	$139,351	$26,046	$26,046	$26,046	$26,046	$104,185
b. Underground	-$5,597	-$1,046	-$1,046	-$1,046	-$1,046	-$4,185
Total	$133,754	$25,000	$25,000	$25,000	$25,000	$100,000

MISCELLANEOUS DISTRIBUTION EQUIPMENT (CODE 601)

TRANSFORMER AND METER DATA	2014-2017	2019	2020	2021	2022	TOTAL
1. Number of New Transformers						
a. Overhead	555	102	102	102	102	408
b. Underground	29	6	5	5	5	21
Total	584	108	107	107	107	430
2. Average Installed Cost per Unit						
a. Overhead	$ 891	$ 865	$ 882	$ 900	$ 918	N/A
b. Underground	$ 2,454	$ 2,118	$ 2,429	$ 2,478	$ 2,528	N/A
3. Total Installed Cost						
a. Overhead	$ 494,602	$ 88,302	$ 90,068	$ 91,870	$ 93,707	$ 363,947
b. Underground	$ 71,172	$ 12,706	$ 12,961	$ 13,220	$ 13,484	$ 52,371
Total	$ 565,774	$ 101,009	$ 103,029	$ 105,089	$ 107,191	$ 416,318
4. Number of New Meters	438	110	110	109	109	438
5. Average Installed Cost	$ 237	$ 265	$ 270	$ 278	$ 283	N/A
6. Total Cost	$ 103,835	$ 29,115	$ 29,697	$ 30,291	$ 30,897	$ 120,000
7. AMI Equipment Cost	$ -	$ 11,646	$ 11,879	$ 12,116	$ 12,359	$ 48,000

MISCELLANEOUS DISTRIBUTION EQUIPMENT (CODE 602)

SYS IMPR0VEMENTS FOR EXIST MEMBERS	2014-2017	2019	2020	2021	2022	TOTAL
1. Number of Services Improved						
a. Overhead	15	16	16	16	16	64
b. Underground	0	0	0	0	0	0
Total	15	16	16	16	16	64
2. Average Installed						
a. Overhead	$606	$585	$596	$608	$620	
b. Underground	$0	$0	$0	$0	$0	
3. Cost of Service Improvements						
a. Overhead	$9,096	$9,354	$9,541	$9,732	$9,927	$38,554
b. Underground	$0	$0	$0	$0	$0	$0
Total Cost		$9,354	$9,541	$9,732	$9,927	$38,554
4. Net Cost of Service Improvements to WEC(after C.I.A)						
a. Overhead-CIAC	$3,906	$4,016.41	$4,096.74	$4,178.67	$4,262.25	$16,554
b. Underground CIAC	$0	$0	$0	$0	$0	$0
Total	$5,191	$5,338	$5,444	$5,553	$5,664	$22,000

MISCELLANEOUS DISTRIBUTION EQUIPMENT (CODES 603-608)

	2014-2018	2019	2020	2021	2022	TOTAL
603 SECTIONALIZING EQUIPMENT						
Number of Cutouts		8	8	8	8	32
Cutouts	$56,378	$1,941	$1,980	$2,019	$2,060	$8,000
Number of Reclosers		1	1	1	1	4
Reclosers	$0	$3,700	$3,774	$3,850	$3,926	$15,250
604 VOLTAGE REGULATORS						
Number of Regulators		0.5	0.5	0.5	0.5	2
	$19,341	$5,102	$5,204	$5,309	$5,415	$21,030
605 CAPACITORS						
Number of Capacitors		1	1	1	1	4
	$1,469	$2,400	$2,448	$2,497	$2,547	$9,892
606 MISCELLANEOUS POLE REPLACEMENTS						
Number of Poles		254	253	253	253	1013
	$1,612,538	$109,181	$111,365	$113,592	$115,864	$450,001
607 MISCELLANEOUS DISTRIBUTION REPLACEMENT						
	$432,403	$194,099	$197,981	$201,941	$205,980	$800,002
608 MISECLLANEOUS CONDUCTOR REPLACEMENT						
Conductor Miles		9.25	10	10	10	39.25
	0	$ 97,050	$ 98,991	$ 100,970	$ 102,990	$ 400,001
610 FAULT INDICATORS						
Number of Fault Indicators		2	2	2	2	8
	$0	$1,213	$1,237	$1,262	$1,287	$5,000

OTHER DISTRIBUTION EQUIPMENT (CODE 700)

	2014-2017	2019	2020	2021	2022	TOTAL
SECURITY LIGHTS--Code 702						
1. Number of Lights	33	4	4	4	4	20
2. Average Cost	$722.91	$910	$928	$947	$966	$750
3. Total Installed Cost	$23,856	$3,639	$3,712	$3,786	$3,862	15000
TOTAL 700'S						
	$23,856	$3,639	$3,712	$3,786	$3,862	$15,000

GENERATION

	2014-2017	2019	2020	2021	2022	TOTAL
Generation						
Code 1203-Coventry Pipe Upgrade	0	351,600	0	0	0	$351,600
TOTAL 1200's						$351,600

UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL UTILITIES SERVICE

REVIEW RATING SUMMARY

BORROWER DESIGNATION: VT 08

DATE PREPARED: June27, 2018

Ratings on form are:	0: Unsatisfactory -- No Records	2: Acceptable, but Should be Improved -- See Attached Recommendations
NA: Not Applicable	1: Corrective Action Needed	3: Satisfactory -- No Additional Action Required at this Time

PART I. TRANSMISSION and DISTRIBUTION FACILITIES

1. Substations (Transmission and Distribution)	*(Rating)*
a. Safety, Clearance, Code Compliance	3
b. Physical Conditions: Structure, Major Equipment, Appearance	3
c. Inspection Records - Each Substation	3
d. Oil Spill Prevention	3
2. Transmission Lines	
a. Vegetation and Line Maintenance	3
b. Right-of-Way: Clearing, Erosion, Appearance, Intrusions	3
c. Physical Condition: Structure, Conductor, Guying	3
d. Line Patrol Program and Records:	3
e. Pole Inspection Program and Records	3
3. Distribution Lines - Overhead	
a. Pole Inspection - Program and Records	3
b. Line Patrol Program and Records	3
c. Compliance with Safety Codes: Clearances	3
Foreign Structures	3
Attachments	3

3. Distribution Lines - Overhead	*(Rating)*
d. Observed Physical Condition: Right-of-Way	2
Other	3
4. Distribution - Underground Cable	
a. Grounding and Corrosion Control	3
b. Surface Grading, Appearance	3
c. Riser Pole: Hazards, Guying, Condition	3
5. Distribution Line Equipment: Conditions and Records	
a. Voltage Regulators	3
b. Sectionalizing Equipment	3
c. Distribution Transformers	3
d. Pad Mounted Equip: Safety - Locking, Dead Front, Barriers	3
e. Pad Mounted Equip: Appearance - Settlement, Condition	3
f. Kilowatt-hour and Demand Meter Reading and Testing	3

PART II. OPERATIONS and MAINTENANCE

6. Line Maintenance and Work Order Procedures	*(Rating)*
a. Work Planning & Scheduling	3
b. Work Backlogs: Right-of-Way Maintenance	2
c. Work Backlogs: Poles	3
d. Work Backlogs: Retirement of Idle Services	3
e. Work Backlogs: Other	N/A

7. Service Interruptions

a. Average Annual Minutes/Consumer by Cause (Complete for each of the previous 5 years)

PREVIOUS 5 YEARS	POWER SUPPLIER	MAJOR EVENT	PLANNED	ALL OTHER	TOTAL	*(Rating)*
(Year)	a.	b.	c.	d.	e.	
2017	7.30	6,274.90	51.00	5.60	6,338.80	2
2016	13.08	59.10	49.60	363.80	485.58	2
2015	1.10	0.70	29.80	285.70	317.30	2
2014	151.60	1,892.50	34.00	270.20	2,348.30	2
2013	38.48	367.00	31.20	401.50	838.18	2

	(Rating)
a. Service Interruptions - outage reporting	3
b. Emergency Restoration Plan	3

8. Power Quality	*(Rating)*
a. General Freedom from Complaints	3
9. Loading and Load Balance	
a. Distribution Transformer Loading	3
b. Load Control Apparatus	N/A
c. Substation and Feeder Loading	3
10. Maps and Plant Records	
a. Operating Maps: Accurate and Up-to-Date	3
b. Circuit Diagrams	3
c. Staking Sheets	3
11. Oil Storage & Handling	
a. Spill prevention containment and control (SPCC) plan	3
12. Avian Protection and Response Plan	
a. Avian Protection Plan	N/A

PART III. ENGINEERING

13. System Load Conditions and Losses		*(Rating)*
a. Annual System Losses	7.10%	3
b. Annual Load Factor	51.3%	3
c. Power Factor at Monthly Peak		3
14. Voltage Conditions		
Substation Transformer Output Voltage Spread		3

15. Load Studies and Planning	*(Rating)*
a. Long Range Engineering Plan	3
b. Construction Work Plan	3
c. Sectionalizing Study	3
d. Load Data for Engineering Studies	3
e. Power Requirements Study	3
f. Energy Efficiency and Conservation Program QA	0

PART IV. OPERATION AND MAINTENANCE BUDGETS						
	For Previous 2 Years		For Present Year	For Future 3 Years		
YEAR	2015	2016	2017	2018	2019	2020
	Actual $ Thousands	Actual $ Thousands	Budget $ Thousands	Budget $ Thousands	Budget $ Thousands	Budget $ Thousands
Normal Operation	1,852	1,945	2,003	2,083	2,166	2,253
Normal Maintenance	1,998	2,356	2,173	2,260	2,350	2,444
Additional (Deferred) Maintenance				0	0	0
Total	3,850	4,301	4,176	4,343	4,517	4,697

16. Budgeting: Adequacy of Budgets for Needed Work 3 *(Rating)*

17. Date Discussed with Board of Directors 7/25/2018 *(Date)*

§1730.24 The borrower's management will discuss this review and evaluation with its Board of Directors

EXPLANATORY NOTES	
ITEM NO.	COMMENTS
	Washington Electric Cooperative (WEC) complies with the conditions normally needed to justify a rating of 3 in the Bulletin 1730-1, Electric
	System, Operation and Maintenance, for all items that received a ration of a 3 on the RUS Form 300.
Part 1.1.b	Field Observations:
	1. Moretown Substation: No issues.
	2. Jackson Corners: No issues.
	3. North Tunbridge: Southeast corner has gap between crushed rock and fence greater than 3 inches. Southwest corner ground rod is above ground.
	4. Mount Knox: No issues.
	The following is a narrative for the items that have received a ration of 2:
Part 1.3.d and	WEC currently performs Distribution ROW clearing on a 9 year cycle. WEC has a 5 year service interruption average of over 2000 minutes/yr.
Part 2.6.b	WEC should consider increasing the frequency of the ROW clearing cycle. WEC experiences financial pressures due to the unusually high
	penetration of solar in their service territory and net metering. This presents challenges in budget priorities while trying to maintain rates.
Part II.7.a	WEC records "Major Events" based on the definition established by the Vermont PSB. If permitted by the Vermont PSB, WEC should consider
	following the recommendations in Bulletin 1730A-119, Part 3, Interruption Analysis.

	NAME	TITLE	DATE
RATED BY:	Dan R Weston Dan Weston	Director of Engineering	06/27/18
REVIEWED BY:	Patricia Richards Patricia Richards	General Manager	06/27/18
REVIEWED BY:	Sara C. Jordan Sara R. Jordan	RUS GFR	06/27/18

WASHINGTON ELECTRIC COOPERATIVE, INC. (“WEC”)

2017 SYSTEM RELIABILITY REPORT

The rolling 3 year average of outages due to “all causes” (exclusive of major storms) is 758, up slightly from the previous rolling average of 755. In 2017, there were 655 separate outages on Washington Electric Cooperative’s system compared to 865 outages in 2016, 721 outages in 2015 and 681 in 2013. The three year rolling average has increased slightly due to the elevated number of outages that occurred in 2016. The total number of consumer hours out in 2017, exclusive of major storms, was 103,504. The average annual number of consumer hours out over the previous three years (2016, 2015 and 2014) is 71,018 and 72,908 over the three years before that (2011, 2012, and 2013) exclusive of major storms. In 2017 there was a substantial (43%) increase in the consumer outage hours out compared to the previous 3year- successive running averages. There are several specific reasons for the increase in total consumer hours out that occurred in 2017 and they are evaluated in the following discussion of service reliability.

In order to more effectively compare trends in WEC’s reliability performance and associated efforts to make improvements in those performance areas, this report generally excludes those outages associated with weather events determined to be “major storms” as defined in WEC’s Successor Service Quality and Reliability Performance Plan in Docket 6984. In 2017 WEC did experience multiple weather events that met the criteria for “major storm”. On May 5/6, May 18/19, July8/9/10, October 29 to November 8 and December 19/20 weather events comprised of severe winds and violent electrical storms or severe winds coupled with wet-snow and icing moved through WEC’s service territory causing widespread and severe damage to WEC’s distribution infrastructure. The 5 major storm events resulted in over 40 broken poles and hundreds of spans of wire on the ground. In every major event the primary cause of the outage was healthy trees, from outside of the Right-of-Way (ROW) corridor, falling onto or through the primary conductors. During the October 29 to November 8 event, GMP owned 34.5kv transmission lines serving 3 of WEC’s substations failed substantially adding to the impact of the severe weather events.

The SAIFI and CAIDI indices for 2017**, exclusive of major storms, were 2.6 and 3.6, respectively**. The SAIFI and CAIDI indices have **averaged** 3.2 and 2.2 over the previous three years and the 2017 data clearly reflects the impact of the severe weather experienced in 2017. While it has been common over the last 10 years to see noticeable variation in the outage frequency index (SAIFI) the outage duration index (CAIDI) has remained well below the target index of 2.7. In 2017 the duration index jumped to 3.6 and the increase is directly related to the severity of the damage caused by weather events that did not meet the criteria to be classified as a “Major Storm”. More specifically, WEC experienced multiple weather events in 2017 where large and healthy trees were blown over onto main-line feeders serving several hundred WEC members. The events often resulted in at least one or more broken poles. The extent of the damage and need to replace the poles in-order to restore power resulted in extended outage duration to a large number of WEC members. The SAIFI and CAIDI performance measures established in

WEC's Successor Service Quality and Reliability Plan are 3.8 and 2.7 respectively. **With the 2017 CAIDI index being the exception, WEC's three and five year averages of these reliability indices continue to improve and are significantly better than the established performance indices.**

Within the last ten years, WEC received funds associated with the American Recovery and Reinvestment Act (ARRA) to supplement the on going effort to implement a system wide coordination scheme of the distribution system. The System Coordination Plan involved, in-part, the replacement of the porcelain A.B.Chance line disconnect devices with a polymer based device. The Plan also required the installation of numerous new disconnects at predetermined locations on the lines. The failure of these line disconnect devices (cutouts) has historically been a leading cause of outages and represents a significant safety hazard for line workers. WEC's efforts to replace these devices have been instrumental in decreasing the number of outages caused by equipment failure over the last 10 years. In 2013, WEC completed the task of replacing/adding all **primary main - line** disconnects identified in the System Coordination Plan. In 2014 WEC gained RUS approval of a new four (4) year Construction Work Plan that continues the effort to strengthen the fault protection scheme of the T&D system. The 2014 – 2017 CWP, in part, targets the replacement of porcelain cut-outs that remain in service and are specific to distribution transformer installations. A significant amount of the remaining replacements occurred in 2014 and therefore did not substantially add to the number of planned outages in 2015 or 2016. However, in 2017, WEC continued an aggressive effort to replace polychlorinated biphenyl (PCB) contaminated transformers which had been installed prior to 1981. Since many of the targeted transformers are located on some of the shortest and oldest poles, an outage is often necessary to safely remove them. As a result the total number of "Company Initiated" outages on WEC's system in 2017 remained above the trending average at 140 but down slightly from 161 in 2016. In addition planned outages were necessary to install and transfer wires onto the 40 or so poles broken during storm events. Regardless, the impact of planned outages remains minimal as the 140 outages contributed only 9,235 consumer hours out.

Trees continue to be the leading cause of outages, accounting for at least 42% (closer to 57% as the "unknown category was likely temporary tree contact) of the total outages and approximately 70% of the total consumer hours out in 2017. In addition approximately 70% of the Company initiated outages took place in order to safely remove trees from distribution lines and transfer conductors from poles broken during storms to new poles. As mentioned earlier, there were multiple wind events that did not meet the criteria to qualify as a "Major Storm" but caused significant damage to the infrastructure on the distribution system. The majority of these outages were the result of large trees located well outside of the cleared Right-of-Way falling onto 3 phase main-line feeders. The "Company Initiated" category came in as the second greatest contributor to total outages and accounted for 21% of the outages but only 8.9% of the total consumer hours out. There was one Power Supplier related outage resulting in 2,537 consumer hours out in 2017 exclusive of those that occurred during the Major Storm events.

In 2017, members served by WEC's Mount Knox substation continued to experience significantly improved service reliability (compared to 2015 and 2016). The areas served by the Mount Knox substation are no longer the least reliable in WEC's service territory. **The Northfield Feeder served by the Jackson Corners substation** was the least reliable area on WEC's system in 2017, net of Major Storm. The Northfield Feeder serves 1,301 WEC members and is remotely located and crosses through some of the most rugged terrain in central Vermont. In 2017 nearly 100 diseased and decayed trees were removed along and adjacent the ROW corridor. Regardless of that effort, the line was subjected to continued outages caused by severe winds which toppled healthy trees onto the line breaking several poles during multiple weather events. On November 10, 2017, ROW crews commenced a comprehensive effort to flat cut and remove any danger trees (healthy or not) from the substation all the way (15 miles) to the end of the 3 phase line. It is expected to take the majority of 2018 for the ROW crew to fully complete tree removal and ROW clearing.

Action Plan

In 2018 WEC will put into place a new 2018-2021 Construction Work Plan (CWP). The CWP is aimed at the continued improvement and enhanced reliability of WEC's transmission and distribution system. The new CWP calls for two-thirds (2/3) of the dollars being spent on reconstruction to occur on circuits that consistently were among the five worst performing circuits. The CWP also outlines improvements including, but not limited to, the following: replacement of small and aged conductors, installation of capacitors to reduce line loss and the increased replacement of deteriorated poles. The CWP will specifically correlate the replacement of approximately 851 aged poles with site specific projects. WEC's reconstruction efforts are on track with the current 2011 - 2020 Long Range Plan (LRP) and the 2017 Integrated Resource Plan (IRP). System reliability will continue to improve as projects are completed.

Fused disconnects installed at strategic locations minimize the number of members affected by any given fault, thereby improving reliability. The line disconnects are composed of a time-proven polymer compound used extensively in the industry on other electrical equipment applications. A closer look at the causes of outages occurring on WEC's system shows a **very significant decline** in consumer hours out due to line disconnect failures. Analysis further shows that systematic replacement of main line disconnects in conjunction with the implementation of fuse coordination, continue to limit the number of members affected by any specific fault. In 2018 WEC will continue the effort to replace any remaining line disconnects associated with transformers in conjunction with a Transformer Right-Sizing program aimed at reducing transformer losses.

In 2013, United Pole Technologies completed their comprehensive pole inspection and treatment program involving approximately 25,300 poles located on WEC's Transmission and Distribution system. In 2014 WEC conducted an inspection of all primary underground installations to ensure they meet RUS and NESC requirements and present no inherent safety or reliability issues. Over the last 10 years, 100% of

WEC's pole plant has been inspected and treated to help prevent decay. The results of these inspections have been used to assess the current condition of WEC's pole plant, and the treatment of the poles will maximize their life cycle value. The inspection data was crucial in determining pole condition and the inspection results were fully integrated into the approved 2014 -2017 CWP. In 2016 WEC launched another 10 year cycle of pole inspection and treatment. In 2017 approximately 10% of the pole plant and ROW corridors were inspected and the effort will be repeated in 2018.

In 2006, WEC's Board of Directors approved a new and comprehensive Vegetation Management Plan that correlates the management of WEC's ROWs to system reliability and specifically to the worst performing areas. Increased funding has since been made available to provide an enhanced level of right-of-way maintenance. The 2015 transmission and distribution ROW budget amount is $918,000 which is adequate to fund a distribution system trim cycle of just less than 8.5 years and a transmission trim cycle of approximately 7 years. The additional funding provided over the last 2 budget years was mostly allocated to WEC's long, single phase lines located in the worst performing areas of the system. The additional trimming did provide improved reliability to those lines. WEC continues to maintain ROW associated with line reconstruction independently of the budgeted ROW efforts. In 2016, WEC was able to remove over 1200 danger trees and in 2017 another 774 were removed. In 2018 we will again locate, identify and remove a large number of danger trees that pose a threat to the distribution system. WEC has significantly reduced the amount of "maintenance cutting" of its right-of ways during the winter months in an effort to control sapling regrowth rates. The majority of the maintenance cutting is performed during the summer months while danger trees are removed during the winter months.WEC continues to pursue and investigate the potential expanded use of alternate methods of ROW clearing including excavator mounted Right-of-Way clearing. WEC's Board of Directors continues to work closely with staff to allow for an effective and affordable ROW maintenance program while remaining cognizant of potential rate impact. Adequate and appropriate funding of the ROW program and ultimately the reliability of WEC's electrical system remains a primary objective.

WEC continues the practice of conducting "foot patrol" inspections of its entire 34.5 and 48 kV transmission lines in the spring and fall of each year. An infrared hot spot scan of equipment and equipment connections within the substations is also done annually. In both cases, any issues are addressed asap and potential outages are avoided.

WEC continues to work with Green Mountain Power, Morrisville Light and Power and Hardwick Electric to secure improvements to the reliability of the 3319 and 3317, 34.5 kV transmission lines which supply WEC's South Walden, East Montpelier and Maple Corner substations. The effort will likely result in the installation of a motorized air break switch at the Morrisville 619 location and CT based breakers at their #5 substation which will allow fault detection and distance location as well as remote switching capability on the Morrisville end of the 3319 line. The effort will improve reliability of the 3319 line and shorten the outage duration if a permanent fault does occur.

In 2017 WEC continued leveraging the significant benefits of the power line carrier (PLC) based AMI meter system. It allows WEC to quickly determine which members are without power and is integrated directly with the Outage Management System allowing for more efficient restoration efforts. The AMI system is a major contributor in the reduction in outage duration over the last several years especially during widespread outage events. In 2018 we will be optimizing the attributes of the AMI system in a continuing effort to further reduce the frequency and duration of outages. We will be using the AMI system to analyze line disturbances in an effort to prevent outages before they can occur. In general, WEC members experienced service reliability that was comparatively among the highest levels in the last 20 years despite an increasing level of weather intensity.

The 2017 Reliability Report is being submitted to the Board by mail and email. A CD containing the same information is also enclosed.

Respectfully submitted,

Dan Weston
Director of Operations & Engineering

WASHINGTON ELECTRIC COOPERATIVE, INC.

VEGETATION MANAGEMENT PLAN

July 2006

I. Purpose

The primary purpose of this document is to provide guidance on methods to be used to manage vegetation within Washington Electric Cooperative's (WEC) rights-of-way (ROW) in a safe, efficient and environmentally sound manner. In providing this guidance, it is understood that all line clearing, maintenance and other vegetation management work shall be performed in strict conformance with all applicable federal, state and local government laws and regulations, including OSHA Rule 29 CFR 1910.269, Electric Power Generation, Transmission and Distribution Regulations.

II. Background

WEC currently serves approximately 10,000 members in 41 rural Vermont towns in the counties of Washington, Orange, Caledonia and Orleans. Today, WEC's electric system consists of 1,237 miles of distribution line and 18 miles of local transmission line, plus an additional 7.4 miles of transmission line in Coventry. Of those line miles, approximately 800 miles of distribution line and 10.47 miles of local transmission line require tree trimming.

The terrain in WEC's service territory is described as hilly, often rugged and for the most part heavily forested with various deciduous and coniferous species. While distribution lines were constructed across fields in the early years of the Co-op in order to minimize time and the cost of construction, WEC has been routinely relocating those lines nearer to roadsides during major rehabilitation projects whenever possible (see Policy 80 attached). However, in many cases, it is likely that landowners will be reluctant to allow WEC to relocate their lines due to aesthetic and environmental impacts.

For the last several years, the WEC Board of Directors has authorized increased funding of the annual ROW budget in an effort to improve reliability. The amount of money budgeted and spent on tree trimming in each of the past four years is as follows:

<u>Distribution System and Danger Tree Removal</u>

Year	2003	2004	2005	2006
Budgeted	$351,000*	$418,000	$436,000	$467,620
Actual	$347,496	$410,993	$435,751	$467,539

* Original 2003 budget was $378,000, but funding had to be curtailed due to budget constraints.

<u>Transmission System</u>

Year	2003	2004	2005	2006
Budgeted	$13,000	$13,400	$13,500	$14,000
Actual	$11,522	$8,121	$10,267	$13,966

The number of miles of line that WEC has cleared and maintained, and the number of danger trees removed, in each of the last three years is as follows:

2003

Distribution Miles Cleared:	54.26	Distribution Miles Maintained:	83.48
Transmission Miles Cleared:	1.20	Transmission Miles Maintained:	2.03
Danger Trees Removed:	700		

2004

Distribution Miles Cleared:	59.94	Distribution Miles Maintained:	85.62
Transmission Miles Cleared:	.78	Transmission Miles Maintained:	1.30
Danger Trees Removed:	900		

2005

Distribution Miles Cleared:	55.12	Distribution Miles Maintained:	84.80
Transmission Miles Cleared:	.98	Transmission Miles Maintained:	1.51
Danger Trees Removed:	1,000		

III. Policy

WEC shall strive to maintain its transmission and distribution ROW corridors in accordance with Policy 80, attached hereto as Appendix A, as well as in the following manner:

a. In a safe, professional, efficient and environmentally sound manner, while being sensitive to the concerns of property owners and the general public.

b. In a manner that will provide reliable electrical service in conformance with the Electrical Safety Code;

c. In a manner that protects all electrical system infrastructure necessary to transmit power between substations;

d. In a manner that uses the services and knowledge of employees and contract ROW crews who are professionally trained and inherently concerned with proper ROW techniques in conjunction with safe work practices.

IV. ROW Management Practices

<u>Inspections:</u>

As part of WEC's annual pole inspection and treatment program, and in accordance with RUS operational planning requirements, a visual inspection of ten percent (10%) of WEC's electrical T&D system shall be conducted on an annual basis. In addition to noting the physical condition of the poles and wires, ROW vegetation growth conditions shall be noted.

Species:

It is the practice of WEC to control the following tree species the full width of the ROW:

Ash	Cherry	Locust	Pine
Basswood	Fir	Maple	Poplar
Beech	Hemlock	Oak	Spruce
Birch	Larch		

This practice of vegetation management control allows for safe passage by WEC employees and contractors within the ROW for maintenance purposes, and removes potential fire and safety hazards to humans and animals in the area.

In general, it is desirable to use or enhance existing natural vegetation that does not interfere with the distribution of electricity. Herbs, most shrubs and low maturing trees should be left in the ROW to suppress the invasion of tall-growing trees. Following is a partial list of some of the low shrubs and plants that are native to WEC's service territory:

Alpine Azalea	Juniper	Rhododendron
American Yew	Laurel	Serviceberry
Dogwood	Leatherwood	Steeplebush
Dwarf Willow	Meadowsweet	Virginia Creeper
Eastern Redbud	Partridge Berry	Wintergreen
Fern	Pussy Willow	Witch Hazel
Gooseberry	Raspberry/Blackberry	

Notification:

In general, the Cooperative membership and affected property owners will be notified prior to any ROW clearing or reclearing maintenance work, except during emergency restoration or if hazardous conditions exist. Such notification shall include one or more of the following:

First: by a general article in *Co-op Currents* listing all ROW maintenance projects scheduled for the year

Second: by a mailed postcard to the member, or to the property owner if different from the member and readily known, who will be affected by the ROW maintenance work

Third: by either an automated or personal telephone call to the member, or to the property owner if different from the member and readily known, informing them that ROW maintenance work is about to commence

General Practices

A. The Removal of Trees by Manual Means (Chainsaws)

This method of control is primarily used for softwood and hardwood trees which have the potential for interfering with line reliability. The principal method of dealing with this type of vegetation is to cut it at ground level (flat cutting) using chainsaws and brush saws. Whenever trees are removed, all stumps are to be cut as close to the ground as practical so as to discourage multi-stemmed sprout regrowth. Side trimming and danger tree removal work are to be performed in conjunction with flat cutting.

B. Trimming/Pruning

It may not always be necessary, economically feasible or aesthetically acceptable to flat cut all trees within the ROW. This may be in response to a property owner's request, when the tree is a compatible, non-interfering vegetation variety, or it may be that while the tree itself is in the required clearance zone, only its branches immediately threaten the electric line. In these cases, it may be appropriate to prune or trim the tree.

Limbs to be removed are those that are dead, decayed, insect damaged, or structurally weak, including limbs which could break at weak points and strike conductors when swinging down in an arc. Pruning guidelines are as follows:

1. <u>Tree Under Conductor – Under Trimming</u>

   Under-trimming is cutting back large portions of the upper crown of a tree. Under-trimming is required when a tree is located directly beneath a line. The main leader or leaders are cut back to a suitable lateral. (The lateral should be at least one-third the diameter of the limb being removed.) Most cuts should be made with a saw; the pole pruner is used only to trim some of the smaller lateral branches.

   For the sake of appearance and the health of the tree, it is best not to remove more than one-third of the crown when under-trimming.

2. Tree at Side of Conductor – Side Trimming

   Side trimming consists of cutting back or removing the side branches that are threatening the conductors. Side trimming is required where trees are growing adjacent to utility lines.

   Limbs shall be removed to the trunk or to a lateral that is growing parallel to or away from the conductors.

   Where possible, or as designated by WEC, the contractor shall eliminate all branches growing within 10 feet beneath and toward the conductors.

3. Tree Over Conductors – Overhead Trimming

Overheat trimming consists of removing limbs beneath the tree crown to allow wires to pass below. Most of the natural shape of the tree is retained in this type of trimming, and the tree can continue much of its normal growth. Overhanging limbs should be removed as dictated by the species of the tree, location, and the general condition of the tree. When trimming, remove all dead branches above the wires, since this dead wood could easily break off and cause an interruption.

The contractor shall remove all weakly attached overhanging limbs that are capable of hitting the conductor if the limb were to split at the point of attachment.

Where possible, all branches within ten (10) feet beneath conductors shall be removed as dictated by the species of the tree, location, and the general condition of the tree.

Overhead trimming must be performed in accordance with current VOSHA/OSHA trimming regulations.

4. Combination Trimming

It is often necessary to use judgment in combining several types of arborcultural trimming techniques in order to achieve a good looking job and provide adequate clearances.

5. Improper Trimming Techniques

a. Pollarding: This is done by stubbing off major limbs until the tree assumes the desired shape. The result is not only unsightly, but a multitude of fast-growing suckers will sprout from the stubs, resulting in a line clearance problem more serious than before. The stubs are quite likely to fall victim to decay and disease.

b. Rounding Over: Rounding over or shearing is done by making small cuts so that the tree top is sheared in a uniform line. This creates an unhealthy condition and results in rapid regrowth of suckers directly toward the electrical conductors.

c. Side Trim Stubbing: This is done by stubbing off portions of limbs along the side of the tree to obtain clearance. This method of trimming, like pollarding and rounding over, creates many fast growing suckers that become a serious line clearance problem. These trimming methods should be avoided.

d. Topping: Removing top and upright branches should be avoided. Where necessary, use natural or directional pruning methods.

C. Proper Trimming Techniques

Various trimming shapes were previously described. The following provides the details for WEC standard line clearance and can be used for overhead trimming, side trimming, under trimming, and combinations. Pollarding, rounding over and side trim stubbing shall be avoided.

All trimming shall be performed to direct the growth of a tree away from the conductors. Branches shall be cut back toward the center of a tree to a suitable lateral branch, parent limb or the tree trunk. This is commonly called drop crotch, lateral or natural trimming (see Figure 1). When cutting back to a lateral branch, the diameter of the lateral branch must be at least one-third of the diameter of the branch being removed in order to sustain growth. Almost all cuts are made with a saw and very little pruner work is required. If a proper lateral branch is not available, the branch shall be cut back to the parent limb or tree trunk.

Trimming shall be done in such a manner as to protect tree health and condition.

All saw and pruner cuts shall be made back to the branch collar at an angle equal to but opposite of the branch bark ridge on the parent limb or trunk in order to leave no stubs.

No damage by loosening or stripping of the bark or splitting of branches shall be caused during trimming.

All severed limbs and branches (hangers) shall be removed from trees after trimming.

C. Removal of Trees by Mechanical Means (Brontosaurus)

WEC shall utilize the Brontosaurus wherever possible to clear ROW. The Brontosaurus is an excavator on steel tracks that utilizes a hydraulically driven shearing mechanism that pulverizes the tree and root system. Having utilized this machine over the past several years, WEC's field observations indicate that it effectively reduces the rate of resprout in many species. The Brontosaurus effectively removes trees, shrubs and brush within a ROW, however, this method still requires contract ROW crews to revisit the ROW to do side trimming and danger tree removals which adds to the cost of this method of clearing. Use of the Brontosaurus is limited due to its inability to safely work in narrow ROWs, and near roadsides and members' homes.

D. Danger Tree Removal

A danger tree is any tree, due to its location, species and condition, which is tall enough to pose a threat to WEC's electric lines. Many of the trees at the edge of the ROW have crowns that are heavily grown in towards the line, and when they fall, are likely to make contact with the electrical conductors. Danger tree removal is most effective towards reducing outages associated with high wind storms, prolonged rain incidents and routine outages due to "rotten trees". This, in effect, targets short-term and long-term reliability while also reducing the duration of outages due to excessive damage. For every danger tree that is targeted and removed, a future outage is avoided. (See Figure 2 for minimum clearances for danger tree removal.)

Since 2002, WEC has been aggressively targeting and removing danger trees in an effort to improve reliability. In 2005, approximately 1,000 danger trees were removed at a cost of $____________.

E. "Hot Spot" Clearing

Selective clearing of ROW line sections outside the normal reclearing schedule helps to improve reliability to those members located at the end of a single-phase line. Identification of these problem line sections normally comes from the members who are affected by poor reliability. Devoting resources to "hot spot" line sections improves reliability and/or power quality to specific problem areas, improves line crew access and outage restoration time, and improves overall reliability of a particular line. Hot spot trimming is the least efficient method of ROW clearing, but is essential to good member relations.

F. ROW Clearing During Emergency Restoration and When Hazardous Conditions Exist

In the best interests of employee and public safety, any tree making contact with WEC's electric system conductors shall be immediately removed to mitigate the hazard. It is not reasonable to provide advance notification to property owners under these conditions.

In the event of a power outage caused by trees within or outside of WEC's ROW, the trees shall be cut to the extent that is necessary to safely restore power. Advance notification to property owners is not possible under these conditions.

Under both of the above circumstances, a WEC employee shall coordinate with WEC's ROW Management Coordinator to arrange for any necessary cleanup.

G. Clearing Within Muncipal Street or Highway ROW

In situations where the Cooperative does not hold a valid ROW easement along a public street or highway, whether for a new service or for relocation of an existing line, no tree within that street or highway shall be cut in the construction, relocation, maintenance or repair of electric power lines without the written consent of the adjoining property owner(s) or occupant, unless the transportation board or selectmen of the town in which the tree is situated, after due notice to the parties and upon provision for a hearing, shall decide that such cutting is necessary (Title 30 VSA, § 2506), or unless such decision is made by the appointed municipal tree warden for the town (Title 24 VSA, § 67).

H. Clearing Within Wetlands

Wetlands are considered to be sensitive areas for vegetation management practices. These may include swamps, marshes and bogs, and other areas identified in the National Wetlands survey, and will be identified by WEC's representative prior to ROW management activities. Handcutting will be used near wetland areas where necessary to control undesirable vegetation. If extensive wetlands are encountered, WEC may elect to carry out the work in winter because of improved access. Vegetation in wetland areas will be managed according to the Vermont Department of Environmental Conversation's policy on wetlands.

I. Clearing Within Stream Corridors

Stream buffers are areas adjacent to streams requiring special vegetation management, and these areas shall generally be maintained to a minimum width of 75 feet on each side of the stream. Where distribution lines cross streams, standing woody vegetation, shrubs and low mature height trees will be allowed to grow within the ROW if consistent with the terrain and existing land use. This cover will protect fish habitat, service wildlife travel lanes, and control soil erosion.

Where the electric line spans a ravine, streamside vegetation may be allowed to grow taller as specified by WEC's representative. Where an undesirable woody species becomes taller than 12 feet, it will be removed to ensure protection of line conductors. In general, provision of the Vermont Agency of Environmental Conservation policy on river and stream bank management shall be followed.

J. Clearing Where Electric Lines Cross Roads

Electric lines that cross roads will be treated similarly to streams. Low woody shrubs, such as Sweet Gale and other compatible plant species identified on page 4, which have a low height at maturity, will be permitted and encouraged at road crossings in order to provide screening of the electric lines.

K. Clearing Within Wildlife Travel Areas

Wildlife travel areas shall be maintained to promote the movement of white-tail deer and other wildlife across the corridor of extended cross-country distribution and transmission lines. In general, WEC's objectives will be to favor vegetation that can support snow and thereby keep the snow depth on the ground shallow enough for deer to move about and to conceal wildlife as it crosses through wildlife travel lanes. Treatment will be similar to high visibility ROW areas, and preference may be given where practical to preserving a conifer canopy. WEC shall use the Vermont Agency of Natural Resources policy on wildlife management as a guide to maintaining wildlife travel lanes.

L. Stump Height

ROW clearing will be limited during winter months. Deep snow during winter months often results in unsightly ROWs because of excessive stump height, which oftentimes need to be recut in the spring, which adds to the cost. Excessive stump height also encourages the regrowth of saplings. At other times of the year whenever trees are removed, all stumps will be cut as close to the ground as practical so as to discourage multi-stemmed regrowth of the original species.

M. Cherry Tree Disposal Precaution

Wilted leaves from cherry trees are poisonous to livestock. Therefore, in areas frequented by livestock, any cherry cuttings shall be disposed of immediately by removing any cuttings from the enclosed livestock grazing area.

V. Trees and Debris Removal

Disposal techniques for each ROW section will be determined by WEC's representative, taking into account federal, state and local regulations, the practicality of certain disposal methods, the potential for wood utilization, and the wishes of the property owner. Whenever roadside trimming is performed, all log length material shall be picked up by a log truck as soon as possible and disposed of in accordance with the property owner's request. All other brush and wood material shall be removed from the ditch and municipal ROW and appropriately chipped or stacked at the tree line. If the ROW maintenance area is located more than fifty (50) feet from a public road or highway, then the log or tree length wood shall be moved to the tree line. All brush shall be windrowed at the edge of the ROW in order to provide unobstructed access for maintenance purposes. All other wood material shall be cut in four foot lengths and stacked at the tree line (see Figure 3). There will be no brush left in stream beds, across fence lines, stone walls, paths or roadways.

VI. Prioritization of ROW Clearing

WEC's Vegetation Management Plan promotes the prioritization of ROW clearing as it statistically relates to reliability of service. In general, the focus of the ROW management program shall be as follows:

1. Transmission Lines

    - Annually patrol 18 miles of local transmission line as well as 7.4 miles of 46 kV transmission line in Coventry for purposes of identifying potential equipment problems and marking danger trees for removal.

    - Flatcut WEC's 10.47 miles of local transmission line as needed to ensure maximum reliability to WEC's substations.

    - Flatcut WEC's 7.4 miles of Coventry transmission line as needed based on annual patrol to ensure 100% availability.

2. 3 Phase Lines

Three-phase circuits are critical links from substations to all members. Damage to one conductor of a three-phase line require the entire three conductors to be de-energized when repairs are made. WEC's three-phase lines are prone to greater damage for any given tree contact due to construction type and phase-to-phase voltage levels. The reliability of three-phase circuits, like substations, have a direct impact on the reliability of all single-phase lines. Improving the reliability of WEC's three-phase circuits is essential to achieving state mandated SAIFI and CAIDI indices.

3. Two-Phase Lines

Two-phase lines shall be treated similarly to three-phase lines as they serve a greater number of members than do single-phase lines.

4. Single-Phase Lines

Maintain single-phase line ROWs based on member density.

5. Worst-Performing Circuits

At the beginning of each year, WEC shall analyze circuit performance for the previous calendar year and identify the five worst performing circuits based on annual reliability. The reliability of the worst-performing circuits shall be further analyzed to determine if there are conditions that can be changed to improve the reliability of the circuits, including danger tree removals, flat cutting, line relocation and reconstruction if needed. In all cases, the circuit analysis shall take into consideration year-to-year fluctuations and longer-term trends to identify root causes of the reliability problems.

VII. CLEARANCE ZONE REQUIREMENTS

In general, single phase primary and/or secondary conductors shall be cleared of trees within 15 feet of each side of the pole line center. Three phase primary conductors shall be cleared 25 feet each side of the pole line center. (See Figure 4 for clearance zone dimension measurements.)

VIII. ROW Contractor Training and Requirements

ROW contractors hired by WEC are required to become familiar with the procedures and requirements of this plan and to utilize safe and proper ROW clearing techniques that are in compliance with state and federal laws and regulations. Each ROW crew must have two (2) qualified line clearance tree trimmers. Minimum qualifications include the following:

- Annual CPR and first aid training
- Annual electrical hazard awareness training
- Ability to perform an aerial rescue from a minimum height of 35 feet in four minutes or less. Aerial rescue must be practiced at least once a year.

- Knowledge of electric line voltages and minimum approach distances
- Annual inspection and dielectric testing of bucket trucks to be used for tree trimming
- *Need to add all references to OSHA 1910.269 material*

This plan has been prepared and adopted in order to provide a broad assessment of WEC's ROW vegetation management goals and policy objectives, and the operational methods and practices that shall be used in attaining those goals and objectives. The procedures outlined herein are designed to provide general guidelines for the safe operation and maintenance of electrical distribution and transmission lines, while minimizing visual and other environmental impacts within the communities served by WEC.

USDA Rural Development

United States Department of Agriculture
Rural Development

RECEIVED

FEB 21 2017

WASHINGTON ELECTRIC CO-OP, INC.
EAST MONTPELIER, VT

FEB 14 2017

Ms. Patricia H. Richards
General Manager
Washington Electric Cooperative
P.O. Box 8
East Montpelier, Vermont 05651-0008

Dear Ms. Richards:

We have received your February 3, 2017 letter requesting a Section 7 CFR 1710.204 waiver/modification of 7 CFR 1710.204(a)(2), which requires submitting a new load forecast to Rural Utilities Service (RUS) for review and approval not less frequently than every 24 months.

We realize that a new 2016 Load Forecast will be a substantial burden on Washington Electric Cooperative (WEC), its members and will result in unnecessary costs since WEC is filing for a rate increase of 5.95%. We understand that WEC revisited the 2014 load forecast work and updated the 2014 forecast data with actual numbers for the past 3 years which results in a flat peak growth and flat energy growth into the future. We find the information provided as acceptable and we waive the requirement to submit a 2016 Load Forecast to RUS for approval. For the next load forecast, WEC can follow the filing requirement in 7 CFR 1710.204 (a) (1) or (a) (2).

Please feel free to contact my office with any questions you may have.

Sincerely,

Chris A. McLean

CHRISTOPHER A. MCLEAN
Acting Administrator
Rural Utilities Service

Washington Electric Cooperative, Inc

P.O. Box 8, 40 Church Street
East Montpelier, Vermont 05651

Telephone: 802-224-2324; Fax 802-223-6780
www.washingtonelectric.coop

Sent by email

February 3, 2017

Sara R. Jordan
General Field Representative | Electric Program
Rural Development | Rural Utilities Service
United States Department of Agriculture
P.O. Box 667
Huntingtown, Maryland 20639

RE: Load Forecast Waiver/Modification

Dear Sara:

WEC is writing to request a modification for load forecast work relative to its upcoming Construction Work Plan and loan application. Specifically, WEC seeks to use its last comprehensive load forecast (2014) as an informational item, to understand factors that drive WEC's load, but update the results for actual outcomes of peak and energy. In this update we will use an expectation of the future that WEC will have flat peak growth and flat energy growth into the future. This outlook is based on actual energy and peak results from the past several years.

WEC understands the requirements and importance of load forecasting as noted and provided in Subpart E—Load Forecasts of Title 7. RUS policies for the preparation, review, approval and use of load forecasts and load forecast work plans is very detailed and specific.

Please note that WEC has consistently complied with RUS's load forecast requirements and we have a wealth of information pertaining to projections of load. As noted in the title, a load forecast is a thorough study of a borrower's electric loads and the factors that affect those loads in order to estimate, as accurately as practicable, the borrower's future requirements for energy and capacity. We understand an approved load forecast, if required by this subpart, is one of the primary documents that a borrower is required to submit to support a loan application.

There is also a section that notes (§1710.210) for good cause shown by the borrower, the Administrator may waive any of the requirements applicable to borrowers in this subpart if the Administrator determines that waiving the requirement will not significantly affect the accomplishment of RUS' objectives and if the requirement imposes a substantial burden on the borrower. The borrower's general manager must request the waiver in writing.

For its upcoming CWP, WEC seeks to use the underlying results of its 2014 load forecast but with updates to the results based on actual data from 2014 through 2016. By way of background, WEC hired LaCapra Associates in 2013 and they produced a load forecast designed to meet RUS requirements. WEC's last load forecast and 2014 -2017 CWP were approved by RUS. The CWP work we did was based on energy and peak results from the 2014 load forecast. Also sent by email is an attachment for reference purposes the 2014 WEC load forecast.

WEC revisited the 2014 load forecast work and updated the forecast data with actual numbers for the past 3 years. We found the 2014 forecast to be significantly higher than what is actually occurring for energy and peak on our system. WEC notes that its actual loads from 2014 to 2016 as compared to the single point forecast are considerably lower than the forecast used in 2014. WECs loads are lower by 2.6%, 3.9%, and 5.0% in the years 2014, 2015, and 2016, respectively.

In 2016, WEC's load requirement in the New England energy market plus internal owned generation (Wrightsville) was 76,736,361 kWh. WEC reached a peak of 15,633 kW on February 19, 2016 at hour ending 19:00 (7 pm) which continues WEC's long standing trend as a winter peaking utility. WEC's summer peak was 13,248 kW which occurred on August 11, 2016 at hour ending 21:00 (9 pm).

Over the past several years, WEC's load has remained relatively flat and it is summarized in Table 1-1. As displayed in Table 1-1, WEC's load decreased by 0.35% from 2015 to 2016. This year's decline is attributed to a mild winter with temperatures above seasonal norms and continued installation by members of distributed generation systems (predominantly solar systems participating in WEC's net metering program). In prior years, WEC's load has also been flat to slightly declining. From 2008 to 2016 WEC's compound annual growth rate was 0.043% while from 2013 to 2016 loads **dropped** by 1.3% over 4 years.

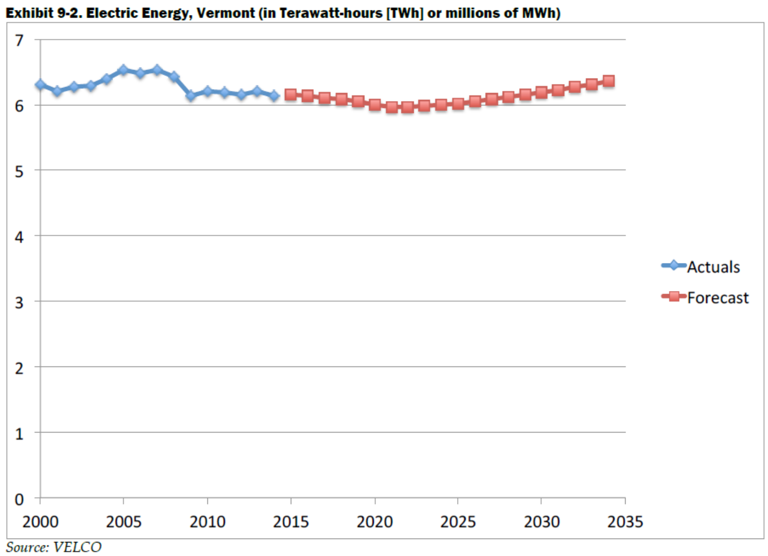
Table 1-1. WEC Actual vs Outlook Forecasts

	Year	Load Obligation (RTLO)	Percent Increase (Decrease)
Actual	**2008**	**76,473,855**	
Actual	**2009**	**76,862,354**	**0.51%**
Actual	**2010**	**77,693,187**	**1.08%**
Actual	**2011**	**77,293,942**	**-0.51%**
Actual	**2012**	**76,504,343**	**-1.02%**
Actual	**2013**	**77,729,681**	**1.60%**
Actual	**2014**	**77,176,986**	**-0.71%**
Actual	**2015**	**77,007,769**	**-0.22%**
Actual	**2016**	**76,736,361**	**-0.35%**
Projected	2017	76,222,268	-0.67%
Projected	2018	76,222,268	0.00%
Projected	2019	76,222,268	0.00%
Projected	2020	76,222,268	0.00%
Projected	2021	76,222,268	0.00%

Based on past data, WEC's load is expected to remain flat with load projected to be 76,222,268 from 2017 to 2021.

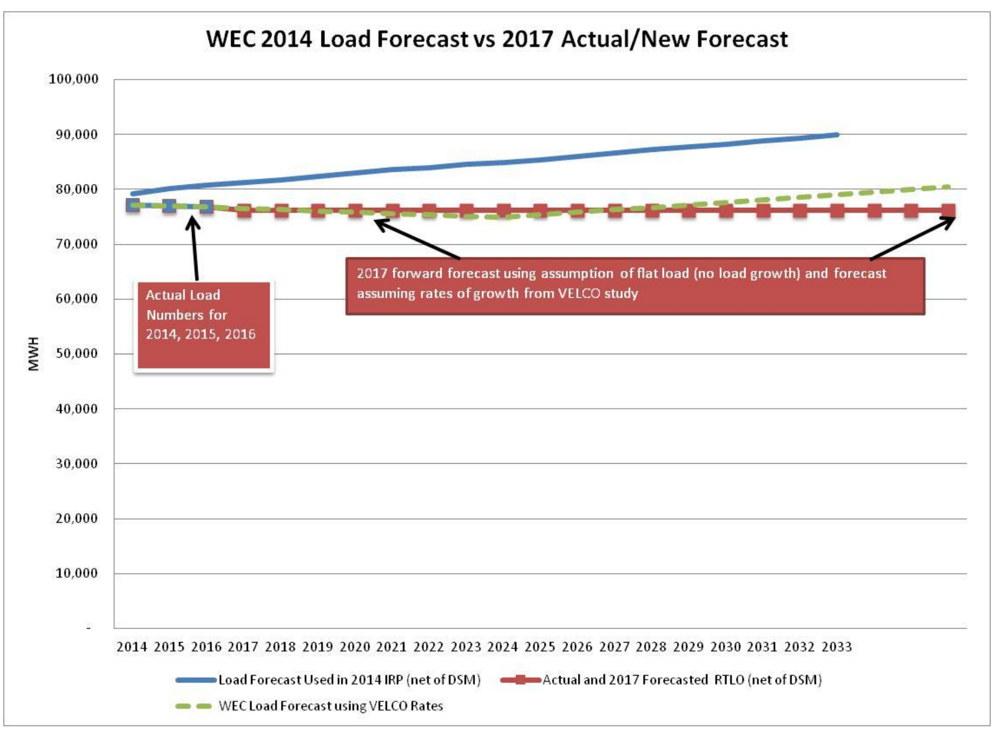
WEC also looked at other recent forecast efforts in the state to confirm our outlook of flat load. VELCO is Vermont's transmission owner and they conducted a comprehensive forecast for the state of Vermont in 2016. Their results call for an average annual electric use **decline** of 0.3% through 2024, followed by an average increase of 0.6% per year through 2034. The VELCO forecast is a thorough, business as usual snapshot of projected electric load growth.

Figure 1-1. VELCO Forecast



Combining WEC's outlook of flat load with VELCO's rates of decline and growths as a benchmark, we note these projections on the same chart as WEC's 2014 forecast for comparison purposes. The results are summarized graphically in Figure 1-2

Figure 1-2. Comparison Forecasts



As shown in Figure 1-2, WEC's flat load projection through the planning period is very similar if we use VELCO's rates of decline and growth that were modeled for the state in aggregate. As a proxy for a robust forecasting effort, WEC believes a flat growth line is appropriate to use in its upcoming CWP. Furthermore, the VELCO forecast work from the 2016 is a good benchmark to support this trend and outlook.

WEC is also using a flat load growth outlook in other major reports and planning documents. In WEC's 2017 Integrated Resource Plan filing with the Vermont Public Service Board, we are using a flat load forecast outlook as well. WEC simply seeks to apply this outlook to the CWP as we think it is accurate and indicative or our future load requirements. We believe it is highly accurate and predictive based on the current known trends of distributed generation, warmer winters, and lower average member use (see figure 1-3 for average member use trends).

We believe using a flat load and peak will not significantly affect accomplishment of RUS's objectives or WEC's CWP. Our last CWP was based on significantly higher loads and no stress points on the system were noted. By using lower loads, this forecast will not alter that outlook of our system as it is already built to accommodate much higher loads.

We also note the load forecast work is very expensive (estimated to be in the range of $35,000 to $40,000). WEC is filing for a rate increase of 5.95% and we are looking at all ways to control costs. Therefore, we believe a new load forecast similar to the 2014 effort is a substantial burden on WEC and its members and will result in unnecessary costs.

Average use among WEC residential members continues to decline. This trend is shown in the Figure 1-3.

Figure 1-3. Residential Average Monthly Use

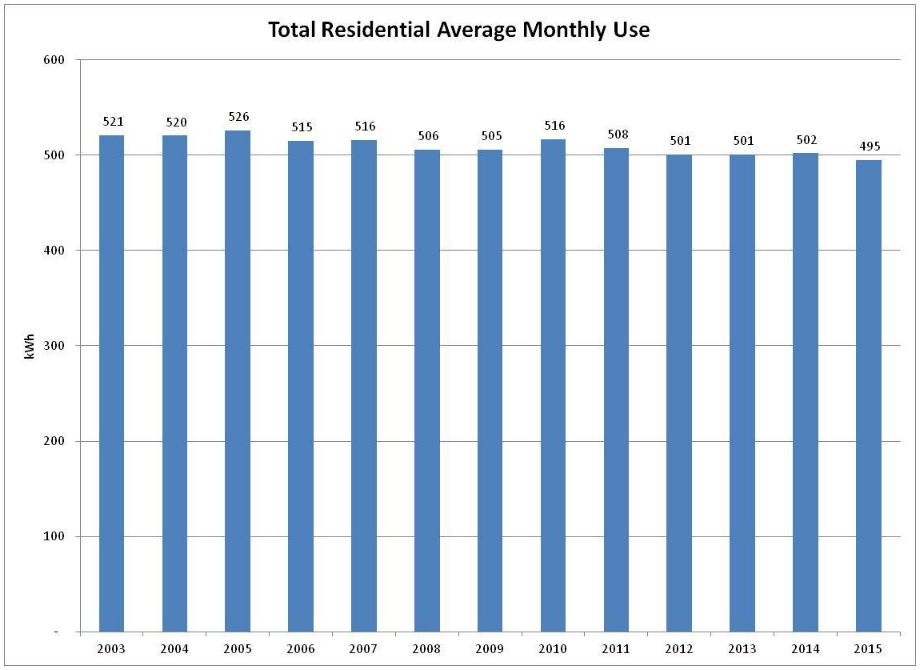
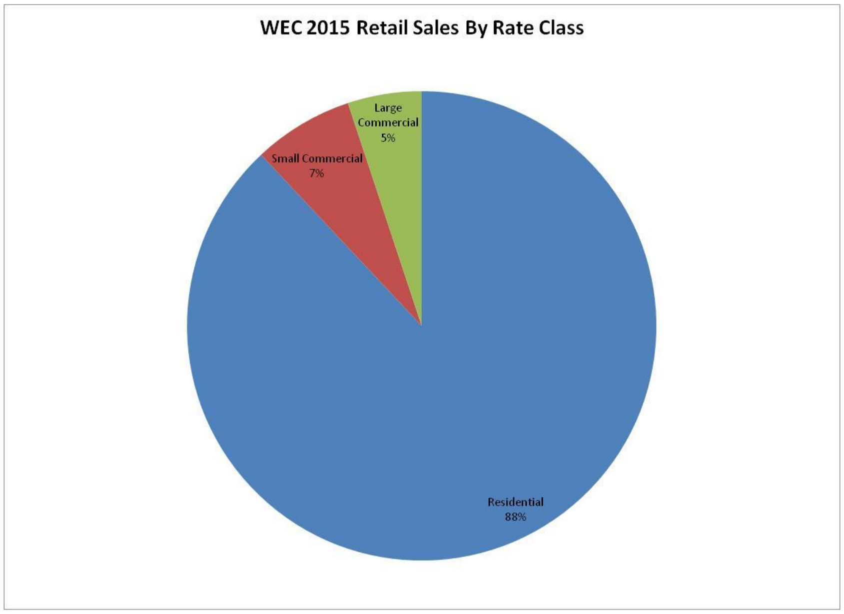


Table 1-2 - WEC Member Distribution by Class

Member Class	2015 Members	% of Total
Residential (incl. Seasonal)	10,325	**95%**
Small Commercial	559	**5%**
Large Power	11	**0.1%**
Total	**10,895**	**100%**

As measured on an energy basis, WEC's retail energy sales are overwhelmingly residential (& seasonal residential), about 88%. WEC also has small commercial and large power sales (schools, office buildings and manufacturing) making up the remainder, about 7% and 5% of the total, respectively. See Figure 1-4 for a graphic summary of WEC's retail sales by membership class.

Figure 1-4 WEC Retail Sales 2015



The importance of showing the member demographics is to note the key driver to changes in WEC's total load. WEC's total load is predominantly driven by its residential member class which does not fluctuate tremendously from year to year. We simply do not have the volatility in load from economic factors which typically drive change to commercial and industrial load. Due to our heavy weighting on residential members, we are focused on understanding changes in the residential sector. By using the underlying analysis in 2014 we understand WEC's electric loads and the factors that affect those loads in order to estimate, as accurately as practicable.

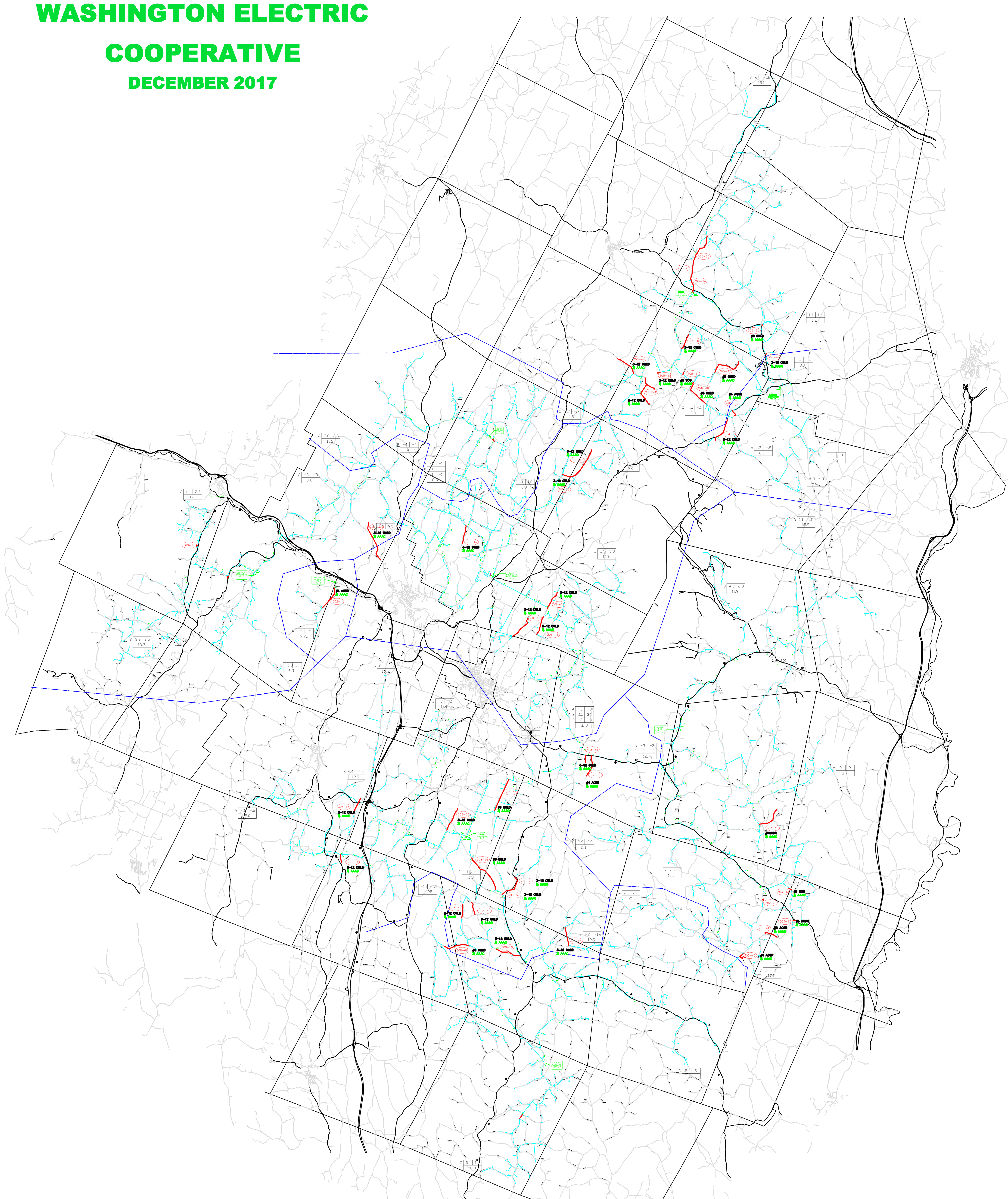
We hope you will consider this request. I am happy to talk in more detail with you about our load and to answer any questions.

Sincerely,

Patricia H. Richards
Washington Electric Cooperative, General Manger

WASHINGTON ELECTRIC COOPERATIVE

DECEMBER 2017



LEGEND:

	DISTRIBUTION SYSTEM
C #6/8 CWC ABC 4/0 AAAC	EXISTING CONDUCTOR, PHASE PROPOSED CONDUCTOR, PHASE
	EXISTING SUBSTATION
	PROPOSED WORK LOCATION
A B C (BEFORE / AFTER)	REGULATED VOLTAGE DROP, 120 VOLT BASE
	MILES TO SUBSTATION

Crocket Engineering, LLC
PO Box 5205, Essex Junction, VT 05453

CONTRACT DWG NO.	PROJECT

WASHINGTON ELECTRIC COOPERATIVE

2018–2021 CONSTRUCTION WORK PLAN

DRAWN: DRC	DWG. No.
LOCATION:	
CHECKED: DRC	APPROVED:
SCALE: n/a	DATE: 12/5/2017
	SHEET 1 of 1