Moses Lake Irrigation and Rehabilitation District
Special Board Meeting
June 09, 2020

**CALL TO ORDER**

At 6:00 PM, President Bailey called the June 09, 2020 Special Board Meeting of the Moses Lake Irrigation and Rehabilitation District to order. The record shows that all Board Members were present. General Manager, Chris Overland was also present. Legal Counsel Brian Iller, Shannon Brattebo with Tetra Tech, Inc., Gene Welch, Ph.D., UW Professor Emeritus, Harold Crose, Chair of the Moses Lake Watershed Council, and others attended via-telephone. The record indicates that this meeting was recorded. The Pledge of Allegiance was then recited.

**DISCUSSION OF AGENDA ITEM(S)**

President Bailey called on the board members and the audience for discussion on any agenda items, and nothing was brought forward.

**APPROVAL OF THE AGENDA**

President Bailey called on the board members to approve the agenda. Director Foster made a motion to approve the agenda. Director Selmann seconded the motion. The motion carried unanimously.

**PRESENTATIONS**

President Bailey announced scheduled presenters Shannon Brattebo with Tetra Tech, Inc. and Gene Welch, Ph.D., UW Professor Emeritus, to discuss their recent research on the Rocky Ford Arm TP Mass Balance report and associated treatment options.

Gene Welch stated the goal was to estimate what various treatments would do in the Rocky Ford Arm of the lake. To achieve that, they needed to consider the various sources coming into the Rocky Ford Arm and make assumptions treating it an individual body of water. He stated the information in the report is calculated on estimates.

Shannon Brattebo stated the objective was to estimate the potential and relative effect of various treatment alternatives for the summer total phosphorus concentrations on the Rocky Ford Arm. Gene Welch and Shannon Brattebo developed the model using data from April to September based on average concentrations observed in 2017-2019. The change in lake phosphorus mass is equal to the sum of all the phosphorus coming in minus the sum of all the phosphorus going out. For the Rocky Ford Arm, there was phosphorus coming in from Rocky Ford Creek, groundwater, and internal loading. The outgoing components are the phosphorus moving out from the Rocky Ford Arm and the phosphorus that is settled into the bottom of that portion of the lake. They calibrated the model to closely match the average concentration for 2017-2019 years and did not verify that the model would reflect lake conditions in other years. Gene Welch had data from looking at specific conductance measurements of the different stations in the lake. He can trace Columbia River water up into the upper half of Rocky Ford Arm. They both assumed that the Rocky Ford Arm was completely mixed. They also assumed that Rocky Ford Creek had a constant average flow of 63 CFS, and Gene Welch was confident this number was fairly accurate with his history of studying the lake. Another assumption was the average total phosphorus of 144 µg/L. The same was used for groundwater, a constant average inflow of 20.5 CFS, and an average total phosphorus concentration of 59 µg/L. Another assumption that Gene Welch and Shannon Brattebo had to make was that the outflow out of Rocky Ford Arm was equal to the inflow. They

did not have a way to measure the hydrodynamic interaction of the Rocky Ford Arm and the Parker Horn area. Shannon Brattebo stated, to model those types of dynamics, you would have to get a much more sophisticated model than just an excel spreadsheet and have quite a bit more data. Another assumption made was the volume of Rocky Ford Arm that was based on historical bathymetry from 1963 and historical reports from the 1980s. For the model, they held constant at the summer full pool elevation from April to October and decreased by 25% in volume during the winter months from November to March. They ran the model for five consecutive years to see if they could come up with reasonable estimates of how each treatment alternative would be effective for five years. Gene Welch and Shannon Brattebo only had surface total phosphorus for 2017 to 2019 but did not have data for the deeper portions of the Rocky Ford Arm. Gene Welch did some research on the historical data and developed a relationship between the surface phosphorus and the water column phosphorus. Gene Welch and Shannon Brattebo's model represents the water column phosphorus through the whole water body.

Gene Welch stated that the bottom of Rocky Ford Arm, where it is 6 meters or deeper, goes anoxic, so they did not have any data for the phosphorus concentration build-up. He researched the historical data from 1986-1988, where they had measured throughout the water column. He took a ratio of the phosphorus concentration and the average in the water column and divided it by the surface concentration. He stated the concentration in the whole water column is 1.8 times the surface concentration.

Shannon Brattebo mentioned the Rocky Ford Arm observed total phosphorus data they used was 54 µg/L for May with an increase until July when it maxes out at 125 µg/L. The increase is due to internal loading. They assumed that because the concentration is groundwater and the concentration of Rocky Ford Creek coming in is not high enough to create that large of an increase. When they first started estimating internal loading, they determined the rate of increase between May and July. Gene Welch stated it would be the observed rate of increase of internal loading, and the actual rate of increase is probably greater. Part of that is due to carp entry. They looked at literature for the intrusion rate of carp and assumed that part of the rate of increase is due to the carp. A calibrated Total Phosphorus Model table was then looked at. The observed May to September average water column total phosphorus was 93 µg/L, and the predicted May to September average water column total phosphorus was 95 µg/L.

Shannon Brattebo stated Rocky Ford Creek contributes about 32% of total phosphorus load to the Rocky Ford Arm. Groundwater was about 4% of total phosphorus load to the Rocky Ford Arm. The Internal Loading, which includes the release from sediments and carp excretion, was 64% of the total phosphorus load to the Rocky Ford Arm. Almost 60% of the 64% of the internal loading is from the sediment release due to anoxic conditions and other mechanisms that will release phosphorus. Gene Welch mentioned the average internal loading for the entire lake, and not just Rocky Ford Arm from 1977 to 1986, was approximately 43%.

Gene Welch had a graduate student collect core samples from 1983 to 1985 and measured the phosphorus concentration in the water over time and then measured the rate of increase in phosphorus that came out of the sediments in cores that were anoxic and cores that had oxygen. Usually, the release that was measured from anoxic cores was ten times greater than from the shallow sediments that would not be anoxic. Gene Welch used his data and calculated the overall rate for the Rocky Ford Arm was 3.5 mg/per square meter per day. This was more than Shannon Brattebo had anticipated. She had always assumed that Rocky Ford Creek, with its high phosphorus concentration, was going to be the main

contributor. Internal loading turned out to be the highest phosphorus concentration contributor. Once the Total Phosphorus Model spreadsheet was built and calibrated, they were then able to test several different alternatives and management scenarios. One of the scenarios they looked at was the water column stripping with Alum. They know enough about Alum that they can assume an 80% reduction of the water column phosphorus in a certain area for an Alum treatment. Using their Total Phosphorus Modeling spreadsheet, they were able to input a phosphorus reduction of 80% for a week chosen to apply the Alum, and it would carry through the rest of the model. They did this for different management scenarios, including water column stripping in three different areas, sediment inactivation with Alum, Alum injection on Rocky Ford Creek, W-20 dilution, and multiple combinations of these management scenarios. The mass balance model is a tool to be able to make the best guess at how the lake is going to respond to the different management scenarios. Predicted summer average water column and surface total phosphorus concentrations in Rocky Ford Arm following various treatment alternatives were then discussed. With only looking at one year, the water column stripping of the 3,928 acres of RFA, takes the surface phosphorus down from 63 µg/L to 41 µg/L. The sediment inactivation, which also includes water column stripping for the whole 3,928 acres of RFA takes the surface phosphorus down from 63 µg/L to 31 µg/L. The best scenarios that result in the lowest average summer phosphorus concentrations were the sediment inactivation and water column stripping for the whole 3,928 acres of RFA, and the W-20 Canal Dilution (30,000 AF over April-September) which brought the average summer total phosphorus levels down to 29 µg/L the first year. Director Selmann stated sediment inactivation is something that occurs once every ten years and asked what the other years that would not get the sediment inactivation would look like. Shannon Brattebo and Gene Welch assumed if you dosed a sediment inactivation treatment properly, you could get at least ten years of effectiveness. They ran the model for five consecutive years, and they believe you can safely assume the release rate will be reduced by 80% and remain that way for approximately ten years. In the first year, there would be an immediate drop out of the water column when you apply a large dose of Alum. However, you would not get it for the next few years. This is why Shannon Brattebo thinks it turns out if you look at sediment inactivation and dilution; it does a really good job the first year because the Alum is stripping the phosphorus out of the water column. However, it carries through for the next few years because you are controlling the internal load and diluting the RFC concentrations.

Harold Crose, Chair of the Moses Lake Watershed Council, asked what the relationship between the reduction from 43 ug/L to 37 ug/L and how that relates to cyanobacteria concentration. Gene Welch stated no one really knows when things become toxic. Researchers looked at data 20 years ago on the fraction of the algae in the lake that was cyanobacteria, and it was found if the phosphorus concentration was above 30 ppb, the probability increases of having 50% of the algae being cyanobacteria. Gene Welch believes even if they could get the phosphorus concentration in the RFA to 37 ppb, it would reduce the amount of algae, which would, in turn, reduce the amount of cyanobacteria as well. Gene Welch does not believe there is a relationship between the concentration of algae in the middle of the lake and microcystins on the shoreline. Harold Crose also asked if you treat 3,928 acres of the RFA, how that would affect the rest of the lake. Gene Welch stated if you have 100,000 acre-feet of Columbia River water coming to Parker Horn, it's shown to keep the phosphorus concentration levels down to 32 ppb and the RFA at 94 ppb. He stated the Rocky Ford Arm is possibly producing most of the toxic algae. He gets the feeling that a lot of the toxic algae is because of the high concentration of the phosphorus in RFA. Gene Welch stated he isn't pushing to treat the RFA; however, if it were done and monitored correctly by sampling the

shorelines and in the lake, you would know what the concentration of mycrocystins is and the concentration of cyanobacteria.

Director Selmann stated it was discussed earlier that there is ten times the release rate for areas that are anoxic, and asked what the acreage is in the depth that would go anoxic. Gene Welch stated areas that are greater than 6 meters; however, they do not have good estimates because they do not have a good bathymetry map of the lake. He believes there needs to be another bathymetric survey of the lake, so they know how much area is covered by each liter of depth. Director Selmann stated if they treated the sediment in the anoxic potions of 600 acres, that it would probably be the best use of money in terms of reducing the internal loading. Gene Welch agreed; however, said the safest thing would be to treat the whole lake. He stated it could be done by having a concentration of 3-4 milligrams per liter of Alum, knowing the depth of the lake and how much Alum needs to be used. Gene Welch stated one thing in Moses Lake is back in the 70s; they monitored in 5 feet of water in Parker Horn continuously. They determined if the wind speed is less than 3 meters per second, the water column would be stable, and the dissolved oxygen would drop. However, when it went above 3 meters per second, the water would mix and get re-aerated again. Gene Welch said if the wind stops, the bottom water can go anoxic even if it is not deep water. He mentioned this because he doesn't want anyone to avoid treating the shallow waters. Shannon Brattebo stated the same thing happens in Grand Lake St. Mary's, Ohio, where the lake is 13,000 acres, and the mean depth is 2 meters. She stated when they did the mass balance model for that lake; they were getting huge contributions from internal loading. She said when the wind stops; the lake is stable for long periods and so much productivity occurring in the lake that it will go anoxic from top to bottom.

Director Dexter asked if dilution of water would decrease the amount of phosphorus in the sediment over the years. Gene Welch stated he has looked at the phosphorus content that was measured back in the 80s, and what has been measured in the last few years in Pelican Horn, and it looks like it has decreased. Gene Welch said he would know more about that when they receive the core samples that were collected a month ago. Gene Welch stated what happens with lakes that have high inputs of phosphorus is when you drop the input by 80%-90% by phosphorus removal, you gradually start transporting more phosphorus out of the lake then coming in. In 1968 at Lake Sammamish, they diverted sewage, and the phosphorus rate went from 10 milligrams per square meter per day to 2.5 milligrams per square meter per day. However, this took 40 years for that to happen. Gene Welch stated Moses Lake has been diluted for over 40 years now and does believe there has been some diluting in the Pelican Horn area.

Director Selmann stated the biggest phosphorus loads from the model are internal loading and Rocky Ford Creek. He asked if Shannon Brattebo and Gene Welch ran a management scenario that included sediment inactivation and Alum injection. Shannon Brattebo stated the Alum injection based on the estimated numbers Harvey Harper, III, Ph.D., P.E. with ERD Water Quality Engineering gave them for the model on the number of gallons per day that it would take would be such a large operation and maintenance cost. Shannon Brattebo and Gene Welch decided to do the W-20 canal dilution water with 30,000 acre-feet and the sediment inactivation because they have high upfront capital cost but have fairly low operation and maintenance costs for the subsequent years. The estimated costs on some of the management scenarios were then discussed. The Alum doses used to calculate the estimated prices are based on jar tests that HAB Aquatics pulled from Moses Lake this spring. Water Column Stripping to the entire RFA (3,900 acres) is estimated to be $4.5 million. Water Column Stripping to the Lower RFA (1,500 acres) is estimated to be $1.9 million. Water Column Stripping to the Lower RFA

with Sediment Inactivation (1,500 acres) is estimated to be $4.6 million. Water Column Stripping to the Entire RFA with Sediment Inactivation (3,900 acres) is estimated to be $10.8 million. Shannon Brattebo mentioned the only way to get rid of the 20% contingency cost she added in would be to go out for bid and get a contractor to negotiate the cost with a chemical supplier. However, Shannon Brattebo stated if Sediment Inactivation is done right the first time, it can get you ten years of effectiveness. For Alum injection, it was estimated to need 7,200-8,600 gallons of Alum per day (two tanker trucks) at $1.00 per gallon. The operation costs will range from $1.3-$1.5 million for six months of injection per year with an initial capital investment of approximately $500,000. The effects of a smaller treated area management scenario are only going to last a year with maybe some carry over into the next year. President Bailey thanked Gene Welch and Shannon Brattebo for giving the presentation and for their input.

**ADJOURNMENT**

The meeting was adjourned.

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Bill Bailey, President

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Richard Teals, Vice President

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Kris Dexter, Director

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Kaj Selmann, Director

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Jeff Foster, Director

By: _____
Secretary to the Board of Directors