INYO/LOS ANGELES STANDING COMMITTEE

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MEMORANDUM

Date February 22, 2017

From: Inyo/Los Angeles Technical Group
Subject: Consideration of the Standing Committee to modify Green Book Box I.C.1.a.ii (Transects for Monitoring Vegetation Response to Pumping)

The Standing Committee's resolution of the Blackrock 94 dispute (4 April 2014) provided that Inyo County and Los Angeles would: "enter into a facilitated process with the Ecological Society of America (ESA) to develop and implement vegetation monitoring procedures and detailed analytical procedures for determining if a measurable change in vegetation has occurred, is occurring, or will occur. The monitoring methods and procedures shall be able to compare vegetation cover and composition to the vegetation cover and composition obtained during LADWP's initial vegetation inventory between 1984 and 1987. The monitoring methods and analytical procedures shall also be able to distinguish and recognize trends in vegetation cover and composition. The Parties shall use the vegetation monitoring and analytical procedures in determining if any change in vegetation cover or composition is measurable pursuant to Water Agreement IV.B and Green Book Section I.C."

In June 2015, Inyo and LA staff agreed to share responsibilities in monitoring vegetation parcels using a set of georeferenced transects that could be annually revisited to track change over time. In August 2015, ESA assembled a team of three experts in vegetation monitoring and data analysis, who were tasked to research and recommend monitoring and analytical methods, including strengths and weaknesses of alternatives. The principal conclusions of the ESA panel were that the current vegetation monitoring and analysis methods used by ICWD and LADWP are widely used and accepted by the scientific community. However, the utility of these methods for detecting changes in vegetation due to groundwater withdrawal could be strengthened by taking the following steps:

1. Review, consolidate, and update monitoring methods and analyses, including selecting a single monitoring protocol (either permanent or randomized transects), determining a consistent sample size based on agreement about the level of change the agencies wish to detect, and considering co-locating some area-based measures with transects to test the feasibility of eventually transitioning to area-based monitoring.

2. Improve the monitoring design to more closely correspond with variation along groundwater pumping and other biophysical and management gradients.

3. Periodically review and as appropriate adopt new technologies, including remote sensing and handheld or aerial sensors, to increase monitoring accuracy.

4. Develop models of groundwater/vegetation dynamics in conjunction with improved monitoring methods.

5. Use applied adaptive management experiments to determine causal relationships between vegetation and factors that affect it, including groundwater, grazing, fire, and invasive species.

Based on the ESA panel's review, the Technical Group revised the Green Book Box I.C.1.a.ii to reflect current monitoring activities conducted jointly by LA and Inyo County. Attachment A shows the specific changes to the original. The enhancements recommended by the ESA panel above are being considered at various stages by the Technical Group.

BOX I.C.l.a.ii TRANSECTS FOR MONITORING VEGETATION RESPONSE TO PUMPING

BOX I.C.l.a.ii

TRANSECTS FOR
MONITORING VEGETATION RESPONSE TO PUMPING

Vegetation transects are included within the Green Book to serve two purposes: 1) to estimate transpiration from a monitoring site, and 2) for use in determining whether vegetation has decreased or changed significantly from the previous cover.

1) Detailed measurements of leaf area index shall be made at each of the monitoring sites using the techniques described in Section III.C. These measurements will be used to estimate evapotranspiration from the vegetation at the monitoring site for comparison to available soil water and, ultimately, to project plant-soil water balance and the need for water table recovery. Vegetation transects shall also be used in cases of suspected vegetation changes due to groundwater pumping. However, rather than using the intensive sampling technique of Section III.D for calculating evapotranspiration, plant cover shall be measured by the line-point technique described below.

2) During the 1984-87 inventory, most parcels were sampled with line-point transects of 100 feet in length, with sampling points at one-foot intervals, providing a two-dimensional representation of vegetation within the parcel. At each one-foot marker, the first contact with the uppermost layer of live plant cover was recorded. Cover and species composition were calculated from all sampling points along the transect.

   The 1984-87 inventory shall be used as a "baseline" to determine whether vegetation cover and/or species composition has changed. This inventory is the only one of sufficient accuracy to permit comparison of species composition and cover.

A subset of the vegetation parcels mapped during the 1984-87 baseline inventory shall be annually monitored to accommodate statistical comparison with data collected during the baseline inventory. Such monitoring may rely on repeat measurement of georeferenced locations using the line-point-intercept method to track live cover and species composition over time. The baseline inventory was summarized at the parcel scale, thus for statistical comparison, transect locations derived from a set of random locations and azimuths provide a valid statistical comparison.

Parcels to be monitored were initially selected based on meeting one or more of the following criteria: (1) parcel contained a permanent monitoring site; (2) baseline inventory data were collected for the parcel; (3) parcel was in close proximity to a pumping well; (4) information of past and current land use for parcel was available; (5) parcel was representative of one of the groundwater-dependent plant communities originally mapped during the baseline inventory; (6) soil characterization was available for the parcel; (7) characterization of the landscape position was available for the parcel. In 2015, Inyo County and Los Angeles began a joint monitoring program utilizing a combination of parcels and transects evaluated and agreed upon by the staffs of both parties. As of 2016, 1,688 transects across 141 parcels are jointly monitored by both parties.

Approximately 100 of the 141 parcels monitored in 2016 will be jointly selected and monitored each year by Inyo County and Los Angeles. Prior to the field season, staff from both parties will determine which parcels of the 141 will be monitored. Existing permanent transects will be used for those parcels selected unless the staffs of both parties agree that a change in transect location is justified and necessary. Transects will be evenly split between ICWD and LADWP. Either party may independently conduct monitoring of additional parcels or transects; however, any data so collected shall be provided to the other party.

The field protocol and calibration for field observations for the joint line-point monitoring program largely follows Herrick *et al.*(2016). At the onset of the monitoring season, staff from both parties shall meet in the field to discuss methods and to calibrate all field personnel. In summary the field protocol is as follows:

(1) navigate to the transect start point with a handheld GPS device;
(2) verify presence of an aluminum tag which has been previously attached to a nearby object (i.e. shrub, debris, etc.);
(3) use a photo taken from the previous year to precisely locate the transect start point and to examine the accuracy of the azimuth used during the previous year;
(4) if the start point on the photo is off by more than 6 meters from the point indicated by a GPS reading, or a start point cannot be positively identified, a start point will be placed at the point indicated by the GPS device;
(5) if the designated transect azimuth is off by more than ±5 degrees from the azimuth depicted within the previous year's transect photo, the designated transect azimuth will be used. If not, the azimuth depicted within the previous year's photo will be upheld;
(6) stretch a tape measure to the direction of the pre-established azimuth;
(7) for each transect, notes shall be taken on whether an aluminum tag is present, and whether or not the current year's start point and compass azimuth matches those depicted within the previous year's transect photo;
(8) record species identity at each half meter starting at 0.5 m and ending at 50 m yielding 100 possible hits;
(9) place a dry erase board with the parcel name, transect number, azimuth and date at the base on the transect line and take a picture from the start point toward the end point that captures the entire transect.

All live cover is tallied for each species for each transect. Data are exchanged at the end of the field season after each party digitally enters and proofs field data.

The field technique and sampling design may be modified to permit detailed statistical comparison if deemed necessary in the future. Statistical analysis will be used to determine the measurability (statistical significance) of vegetation changes from the 1984-87 baseline inventory maps. Such an analysis may include, but is not limited to, Welch's test (t-test with unequal variance), Wilcox test (Mann-Whitney test), Analysis of

Variance (ANOVA) and Generalized Linear Model (GLM) for vegetation cover and permutational Multivariate Analysis of Variance (PERMANOVA) and Nonmetric Multidimensional Scaling (NMDS) for vegetation composition. For parcels with small baseline inventory sample sizes (e.g. 1-4 transects), a one-sample t-test may be performed using the baseline inventory sample mean as the null hypothesis for the test. Determination of measurability will be made by the Technical Group on case by case basis in accordance with Water Agreement IV.B and Green Book Section I.C.

Box I.C.1.a.ii shall be modified as necessary in the future to incorporate new or modified field techniques, technology, and/or analytical methods. Such changes will be jointly developed by the staffs from both Inyo County and Los Angeles and will be presented to the Technical Group for consideration.

References

Herrick JE, Van Zee JW, McCord SE, Courtright EM, Karl JW, Burkett LM (2016) Monitoring manual for grassland, shrubland and savanna ecosystems. Second Edition. Volume I: Core Methods. Advance Copy. Available at http://www.landscapetoolbox.org/wp-content/uploads/2016/02/MMGSSE_20160210.pdf