Standard Operating Procedures under sub-rule (4) of rule 91 of Rajasthan Minor Mineral Concession Rules, 2017 for carrying out drone survey and submission of digital aerial images of mining lease areas

Background:

To leverage the use of technology, it has been notified to use a combination of digital aerial (Drone and satellite) images to monitor mining activities in the State.

Through Satellite imagery, one can view the activities including mining that take place on the ground without human interventions. Based on the time series satellite imageries for different periods, change detection study in the mining activities of a mine can be studied pertaining to lateral changes in a broad view as well as volumetric calculations based on stereo pair satellite imageries.

In addition to this, Drones, operate at much lower altitudes as compared to satellites and are also able to provide unique data with regard to spatial resolution and angle of view. Compared to satellite images, drone images can provide lower ground sample distances (GSD) or higher spatial resolutions on the ground.

The advantages of Drone Survey are:-

(i) Drone Survey in mining improves the overall efficiency of mine management by providing accurate and comprehensive data detailing site conditions in a very short time.

(ii) The data accuracy and authenticity is better than the traditional survey.

(iii) High resolution (cm level) data of Drone provides high accuracy and more precise volumetric measurements than traditional surveying methods.

(iv) Stocks of irregular shape and exhibiting craters can be easily surveyed with great precision than using traditional methods.

(v) Drone Survey is a minimum human intervention based survey mechanism that is faster and easily repeatable at low cost.

(vi) Changes between two surveys can be tracked and highlighted automatically.

(vii) Drone aerial images can be used to generate point clouds, digital surface models, digital terrain models and a 3D reconstruction of a mining site, including its stockpiles.

(viii) Helps in creating a digital data base which can be used and retrieved at ease and compared.

(ix) Data generated over a period of time can be stored in digital platform and the time series data can be compared. The data can be used for systematic and scientific mine closure planning, monitoring of reclamation, rehabilitation activities in lease area.

With the above objectives in view, the State Government has amended the Rajasthan Minor Mineral Concession Rules, 2017 vide notification dated 24.10.2024 requiring submission of drone survey data and orthomosaic images along with annual return and mining plan/mining scheme, use of drone survey in preparation of mining plan/mining scheme and volumetric assessment of mining lease/stocks.

Accordingly, in exercise of powers conferred under sub-rule (4) of rule 91 of the Rajasthan Minor Mineral Concession Rules, 2017, the following standard operating procedure is issued for carrying out drone survey and submission of digital aerial images to the Department by the mineral lease holders/bidders:-

(1) Drone survey Permissions:

(i) Drone Agency (individual/s or partnership firm or company or association of person) deployed by the Lessees to undertake mine surveys shall adhere to all the rules, regulation, guidelines etc. notified by Directorate General of Civil Aviation (hereafter referred as DGCA) from time to time. Drone Survey must be conducted as per rules prescribed by the Ministry of Civil Aviation.

(ii) The survey may also be carried out by lessee themselves by following all the applicable rules and guidelines as mentioned above.

(iii) Prior to flying of Drone, the lessee shall check the airspace map published by DGCA in the given link https://digitalsky.dgca.gov.in/airspace-map/ or published by DGCA from time-to-time and shall obtain necessary DGCA permission prior to flying in Red and Yellow zones/Restricted zones.

(2) Drone Specification:

Drones used for the survey should be DGCA approved and should possess mandatory safety features as notified by DGCA from time to time.

(3) Sensor/Camera Specification and output data resolution:

(i) The camera used in the Drone should be of minimum 20 mega pixel or above resolution RGB camera with capability to capture high quality undistorted pictures.

(ii) Camera should have the resolution to capture the images less than 5 cm Ground Sample Distance (GSD) or 5 cm per pixel.

(iii) The Resolution of Digital Elevation Model (DEM) should be 15 cm per pixel or better.

(4) Drone flying path and flying height:

(i) In order to ensure the generation of a height model photogrammetrically (e.g. Digital Surface or Digital Terrain model, DSM & DTM), images should be acquired with proper overlap.

(ii) The Drone survey should be planned in such a way that the forward (front) overlap should be minimum 80% and lateral (side) overlap should be minimum 70%.

(iii) The Flying Height of the Drone should be as per DGCA prescribed limits, however, the resolution of the Drone image should be very high i.e. upto 5cm GSD or 5cm per pixel or better.

(iv) Camera angle nadir direction should be vertically downwards (90-degree angle) while carrying out survey.

(5) Survey Area:

(i) The survey should cover the entire mining lease area capturing all mining, allied activities and 100m beyond periphery of the mine lease boundary to monitor the environmental impact and ascertaining any excavation therein.

(ii) The flight path plan & the numbers of flights taken to cover the entire area shall be provided to concern Mining Engineer or Assistant Mining Engineer alongwith the output data.

(iv) For leases having common mine boundary, the survey shall be limited to the concerned sides of the lease boundary which is common with another mining lease/s.

(6) Ground Control Points (GCPs) for Drone Survey:

(i) Before undertaking Drone Survey, each mining lease must establish at least four GCPs per 100 hectares of lease area or part thereof with calibrated/certified DGPS instrument. If the area is less than 100 hectares, the minimum GCPs required shall be three numbers.

(ii) The GCPs should be well distributed all over the Survey area. GCP must be easily visible in the images obtained from Drone survey.

(iii) The dimensions of GCPs thus established should be minimum 50 cm. by 50 cm. (marked as X with high contrast colours).

(iv) At least two permanent GCP shall be placed at undisturbed locations and has to be covered in the subsequent surveys to cross check the error in change detection and other analysis. The error of GCP should be not more than 5 cm.

(v) The boundary pillars should not be considered as permanent ground control points.

(7) Drone Survey Time:

In order to maintain consistency in quality of images, it is recommended to carry out the drone survey in better light condition when the sun is overhead to minimize the shadows in photographs.

(8) Co-ordinate Reference system:

(i) The co-ordinate reference system to be used for acquiring the drone survey images will be Geographic Coordinate System (GCS) with WGS84 Datum and Decimal Degrees / Degree Minute Seconds as units.

(ii) The ortho-mosaic shall be submitted in the Universal Transverse Mercator (UTM) with WGS-84 datum and units as Meters.

(iii) The GCPs survey data and boundary pillar co-ordinates data shall be submitted in latitude and longitude (Deg. Min. Sec.) format in WGS 84 datum.

(iv) The precision of the data submitted in GCS with WGS84 Datum should be in the format as (DD MM SS.SSSSSS).

(9) Preservation of Raw and Processed Data:

As per sub-clause (dd) of clause (iv) of sub-rule (2) of rule 28 of Rajasthan Minor Mineral Concession Rules, 2017, lessee shall submit processed output images obtained from drone survey to the Department along with annual return. The lessee shall keep the raw and processed data of each survey in safe custody with them for a minimum period of five years and if at any stage, the raw and processed data are required by the Department for verification purpose, same will be made available to the Department.

(10) Data output/formats and submission:

(i) The processed output data of the drone survey will be in the formats as specified in **Annexure-I**, annexed to this SOP. The survey report shall be signed by the authorized person of the Agency.

(ii) The output data shall be submitted to concern Mining Engineer/Assistant Mining Engineer, in soft copy only in storage media (i.e. external hard disk), on or before 1st day of July every year along with the details of the survey carried out as per the **Annexure-II**, annexed to this SOP by each lessee to the Department for the preceding financial year.

Annexure - I

S. No.	Data type	Format
1.	Orthomozaic image of lease area including 100m buffer zone.	.tiff (geo tiff)
2.	Digital Elevation Model (3D) – DSM & DTM	.tiff (geo tiff)
3.	GCPs data (Datum-WGS 84, GCS)	.shp and MS-Excel
4.	RMSE Report	.txt/.doc
5.	Map of the mining lease showing area of; a) actual excavation (mineral and waste), b) Mineral storage c) Subgrade dump, d) Waste dump, e) Afforestation, f) Backfilled, reclaimed and rehabilitated area Within the lease for the preceding financial year;	.shp (in WGS 84 Datum in UTM Projected Coordinate system)
6.	Lease boundary pillar co-ordinates (as authenticated by state government should be submitted both in GCS and PCS in Datum WGS 84)	.shp and MS-Excel
7.	Drone Survey log sheet	.doc

Date:

Place: Signature of Lessee

Signature of Authorized Person of the Agency

Annexure - II

Output data submission form for Drone survey for the year ……..

S. No.	particulars	Details
1.	Name of the lessee, Address, Phone and email	
2.	Location of the mine (Village/Tehsil/District)	
3.	Total Lease Area (Ha)	
4.	Mining Lease Number	
5.	Mineral	
6.	Method of mining (Opencast/Underground)	
7.	Name of the Drone Agency	
8.	Remote Pilot license No.	
9.	Unique Identification Number (UIN No.) of Drone	
10.	Category of Remotely Piloted Aircraft (Nano/ Micro/ Small/ Medium/ Large)	
11.	Type of drone (fixed wing/multi rotor) with specification	
12.	Survey Start Date and End Date and time (DD/MM/YYYY) complete log sheet to be provided	
13.	Name of the pilot and observation during the survey (if any)	
14.	Type of sensor/camera used along with specification	
15.	Height of the flight (above ground level) and altitude (meter) of ground where drone flied	
16.	Total number of GCP's	
17.	Device used for the collection of GCP	
18.	Total RMSE (Root Mean Square Error)	
19.	Name of the Agency who have processed the output data	
20.	Software used for processing the data	
21.	Total excavation from the beginning of the mining lease in cu.m. (mineral and waste)	
22.	Actual excavation during the preceding year in cu.m. (mineral and waste) as per annual return submitted to Department	
24.	Data folder name and size	
25.	UTM Zone considered in Projected Coordinate System	

Date:

Place: Signature of Lessee